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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Construction Labor

IN THE spring this journal warned those who were figuring their highway bids on the theory that wages would fall later in the year that they were taking dangerous chances. The correctness of our expectations is now being proved. Labor has not been plentiful and has been held only by wage increases. Unfortunately, all work is backward this season despite the strong urging, immediately after the signing of the armistice, to make preparations for the next season's work. Had work been let and started in proper time much of it would have been done at the lower wages. As it is, prudence would indicate the wisdom of pushing work as hard as possible so as not to carry it over into next year. Price and wage recessions may come by April, 1920, and for that we all earnestly hope. On the other hand, there may come an advance. The wise contractor will get his work out of the way.

Low-Production Crisis

TWO weeks ago we suggested that the President was the natural leader in the present high-cost-of-living and low-production crisis. He sounded the note in his cost-of-living message to Congress. Now he follows it with an address to the country and to the railroad shopmen on the occasion of granting the latter a wage increase. He does not exaggerate, in our judgment, when he says: "We are face to face with a situation which is more likely to affect the happiness and prosperity, and even the life, of our people than the war itself . . . An admirable spirit of self-sacrifice, of patriotic devotion, and of community action guided and inspired us while the fighting was on. We shall need all these now, and need them in a heightened degree, if we are to accomplish the first tasks of peace. They are more difficult than the tasks of war—more complex, less easily understood—and require more intelligence, patience and sobriety." So far, so good, but the end is not yet. There is need for a continued propaganda and an exercise of the great influence of the Presidency upon all who labor, whether with the hand or with the brain. The need is for greater production. Going with that need is the requirement that profiteering shall be stopped. To that end the Government is addressing itself with energy. The other task the President has begun, but there is need for continuing his propaganda.

Aims of Engineering Schools

THE controlling considerations in the selection of the teaching staff and in the planning of the instruction in the new Harvard Engineering School are thus stated by President A. Lawrence Lowell: "To train men to think; to lay a broad and deep foundation with a superstructure which can be completed only gradually from the training and observation that come from practical experience; to encourage the student to understand each problem so thoroughly that he can apply the same principles intelligently in the solution of different kinds of problems; and, finally, to train men to be good citizens as well as good engineers." President Lowell has expressed in a few words the principles that are probably subscribed to in theory by all engineering teachers, but which, on an impartial study, many of them would have to admit had been violated in the planning and conduct of engineering courses. What we have been trying to do in discussions of engineering education lately is not so much to discover new principles as to prove again to ourselves the validity of old principles, and to inquire whether the methods we have been pursuing square with what is sound in theory. President Lowell's declaration is a good one. We find the same principles widely subscribed to. We hope, however, that all who accept them in theory will remember the homely phrase that "the proof of the pudding lies in the eating thereof." Do engineering courses produce the results that President Lowell lays down as the purpose of the new engineering school?

Airplane Travel

SPECULATION has naturally been rife among laymen as to the probability of the early introduction of the airplane into regular passenger service. Its possibilities appear to be so great that one is eager to see the predicted development begin. For some time there has been regular passenger service between Paris and Brussels, while this week's cables tell of the inauguration of service between London and Paris. Those who have studied the situation account for the slowness of development on two grounds—the natural conservatism of capital in venturing into a new and untried field beset, apparently, by peculiar hazards, and the lack of suitable, centrally located landing fields. They do not believe that the dangers of airplane travel when calmly considered are a deterrent from the standpoint of the operating company, though the risks may tend to discourage prospective passengers. Airplane travel, of course, is not attended with the degree of safety of rail or even water travel, but the constant use of airplanes for transporting British diplomats between London and Paris, from the very beginning of the peace conference, shows the confidence of the British air service and British officials in this mode of travel. Safety measures are receiving careful study—parachute experiments, for example—and these will go far to remove the fears that the public now entertains. As to landing fields, a new civic and civil engineering problem enters here. The landing of passengers far out in the suburbs is naturally a handicap, even though

automobiles are in waiting. In this respect, too, advances are to be looked for. Landing and starting in smaller areas than are now felt necessary will surely come. Incidentally, the success of the New York-Washington airplane mail service should not be forgotten. It gives warrant for the optimism of those who contend that there is no physical reason why a New York-Chicago passenger airplane service should not be in operation.

Lake Port Planning

THERE can be little doubt that the future development of our Lake ports will proceed along lines different from those followed in the past, though not much has been done toward planning this future development. With one or two exceptions, all are narrow river harbors, and most of them cannot remain such if they are to handle large volumes of water traffic. The proposal made that the Chicago River be closed and its functions turned over to a lake-shore harbor, noted in a brief item in our issue of Aug. 14, is new evidence of the fact that Lake port planning is behindhand. No one will venture to claim that, if the river were closed forthwith, lake-front facilities could be made ready within a reasonable time, or even that a sound lake-front plan could be agreed upon in the near future.

Cleveland's long-continued efforts to begin river-straightening work, and its construction of lake-front piers at the same time, show that the inadequacy of existing harbor facilities is making itself seriously felt. It would seem also that at Cleveland the river interests have unusual strength, as is but natural in view of the existence of many industrial sites along the river above the city. In Milwaukee thought has also been directed to the port problem, though in a very different way. A disastrous collision two years ago brought the evils of the river-harbor system there painfully into view. *Engineering News-Record* at that time suggested abandoning the river as a harbor, and the same thing was later recommended by a local engineering body, after study of the situation. The case of Chicago is closely analogous to that of Milwaukee.

There is no lack of difficult questions involved in the general problem of developing the lake ports along progressive lines. Yet no study of the problem has been made, so far as we know. The Cleveland planning and what has been done by the Chicago commission may possibly be regarded as preliminary steps toward a full study. However, not only the harbor and its dockage need to be considered, but also the means of integrating them with the city—its markets, its industries and its railways. Each feature is merely a detail in the broad program of development which must be followed if results of maximum value are to be realized.

Nowhere in the country has water transportation so important a meaning as along the Lakes. Yet, despite the excellence of the natural transportation facilities at the disposal of the Lakes cities, general freight commerce has failed to grow. If the great advantages in productive power given by these facilities are to be retained, the terminal problem—the Lake-port problem—must be worked out. For the present, inertia and the hampering influence of long-established river habits stand in the way of adequate recognition of its importance.

Drawbridges as Machines

WHAT causes led to the remarkable breakdown of the Lincoln Highway swingbridge over the Passaic River have not been fully cleared up. But it is certain that the observations made in the course of the repairs now completed (see *Engineering News-Record* of Aug. 21, 1919, p. 366) lay significant emphasis on maintenance as a vital essential of good drawbridge service.

At the time the dangerous state of this bridge was reported, progressive deterioration of the turntable had gone so far as to threaten destruction of the bridge. No causes lying outside the turntable itself were then known, but the article points to several of these causes. It is clear that every movable bridge should *as a whole* be considered a machine, needing skill and care in inspection, adjustment and renewal of parts. But this point is often undervalued; there is a temptation to regard a drawspan as the equivalent of a fixed structure with the addition of some simple mechanism that will take care of itself. The present case shows that such a faulty view may result not only in waste of money but in serious danger.

Furthermore, it is worth noting not only that the complex mechanical elements of such a span are the portion which is most likely to give trouble in service, but also that the structural and mechanical conditions of the bridge may be interdependent to an unexpected degree. This interdependence may account for many of the observed conditions in the Passiac River draw, not easily explained by themselves. Among the factors that seem to have been involved are inadequacy of expansion provision in the approach spans, settlement or tipping of abutments and rest piers with resultant fouling of the draw by the approaches, displacement of the turntable center, uneven bearing of the rollers, and irregularity of the upper track. Several of these factors exerted mutual influence, or, perhaps, some of them were created by others. Which were primary and which secondary has not been made evident. But if the possible sources of trouble in a drawbridge are so numerous, the special importance of careful maintenance and of early attention to any improper condition is quite obvious.

The Asphalt Association

AS THE readers of this journal know, a group of competitive companies has recently formed the Asphalt Association, an organization for the promotion of their product. Associations of that kind have come to be the rule in forward-looking industries. Their formation is an advantage to the fields they serve, and we have no doubt that engineering work will profit no less from the coming of the Asphalt Association than it has from the advent of similar bodies.

The advantages that accrue from association work flow chiefly from the consequent enlarged viewpoint which the individual members take of their opportunities and of their responsibility to the public and that special branch of it which they serve. Selling problems, which naturally dominate the individual company when left to itself, are tempered with a new and higher ideal of service, even though the company has hitherto given much thought to service to its customers. In saying that, there is no reflection on the past procedure of the asphalt companies. The same raising of standards

has been noted in the metal-lath, the lime, the cement, the brick and other industries. The reason for it is not hard to find. When proceeding alone, the selfish motive naturally comes to the fore. When an association is formed and progressive American business men discuss their mutual problems, the greatest good of the greatest number is sure to dominate and control policies—and that requires the rendering of a very superior service. As one bit of evidence in support of this view one needs only to recall that practically every industry upon the formation of a promotional association has established a research laboratory in which the general problems of the industry and of the given field are studied. It does not assume the research work of the individual companies, but takes up the broader problems. Such study is certain to benefit the given field and the public in general.

Another benefit that always follows in the wake of promotional associations is a recognition of the limitations of the product. A company cannot profit over a long period of years by selling its wares for uses for which they are not fitted. Yet that very practice is found in many industries. The progressive companies refuse to indulge in it, and when association work is established their views—the higher standards—dominate. In the asphalt industry, no less than in any other, there are limitations that should be set—to the gain of the public and of the industry itself.

Nor are the benefits to be deprecated merely because such procedure happens at the same time to be "good business." In fact, the rendering of a superior service should properly be attended with higher rewards to those who give the service.

The Asphalt Association has a great story to tell. Material for the propaganda is at hand in abundance. Its analysis and publication will be a help to the engineering profession. We wish the association success in its endeavors.

The Motor Bus for City Traffic

IT WILL not do to dismiss lightly the statement of Mayor Hylan of New York that the future of surface transit lies with the motor bus, be it in New York City or elsewhere. His statement of Aug. 7 may have been made in a moment of pique, and his figures may be somewhat awry, but some new phenomena in street-railway strikes compel attention to his remarks upon the supersession of the street railway by the motor bus.

Hardly two or three years ago a street-railway strike meant practically complete paralysis of the community. A few weeks ago there was such a strike in Pittsburgh. In the words of a neighboring electric-railway manager, "the Pittsburgh strike created hardly a ripple." In New York we still carry a vivid recollection of the strike of the Brooklyn Rapid Transit employees, early this August. Inconvenience the Brooklyn strike caused aplenty, but after the second or third day mighty few people failed to get to their work or business on time. What was the reason? The motor truck impressed from every line of industry!

As if by magic, thousands of trucks appeared from everywhere. Some had boards or commandeered chairs for seating. Most had nothing at all except standing room. But, mark, *they got there*, and in less time than had been required by the street-car straitjacketed to the rails. In Brooklyn the acting borough president actually obtained 300 passenger motor-buses from Newark, much as Winston Churchill had requisitioned exactly the same number of London buses in October, 1914, to provide emergency transport for the Antwerp expedition. Such successful improvisation of transit facilities could hardly go unnoticed by a layman, and we hope its lesson will not be lost upon the street railways themselves which are logically the means to coördinate all methods of mass transportation, whether on rails or rubber.

There is no warrant for Mayor Hylan's assumption that bus riders can be carried at a 5c. flat fare, but if to the American people is offered faster and more comfortable travel than that afforded by the street car, they will pay the price willingly. Nor is there any immediate prospect that the surface lines of New York need be torn up if the operating company realizes that since it cannot compete with the rapid-transit lines for the long rides at a flat fare, its proper field is short-haul traffic at short fares—in brief, the zone system as just adopted by the Public Service Railway of New Jersey. The abandonment of such routes as the 28th and 29th St. lines in New York is a missed opportunity to give the short-ride fare a trial. A motor-bus line, with a graduated fare, put in its place, would stand a better chance of making money; first, because a vehicle that goes right up to the curb is a strong invitation to ride; second, when the buses were no longer busy after the commercial hours, they could be transferred at once to avenues where pleasure traffic is heavy, or rented out to clubs for outings, as in the palmy days of the electric railway.

Doubtless, the matter of greatest interest to the highway engineer will be the question of the weight and number of such auto-buses. Mayor Hylan refers casually to such monsters as 80 to 100-passenger vehicles, probably having in mind the great sightseeing trucks. Of these, so small a number is in use that their effect on road wear is insignificant; nor are they used in intensive all-day, frequent-stop service. The standard bus of the Fifth Avenue Coach Co., seating but 44 passengers, weighs five tons, while the proposed enlarged bus of the London General Omnibus Co.—the result of years of experience—will seat no more than 46. The New York company is already using pneumatic tires on some buses as a reducer of gasoline and upkeep, and the London company is planning to do likewise.

It is probable, therefore, that the motor buses of the immediate future will not weigh any more than many loaded motor trucks. Any paving that can bear up under the big, solid-tire freight carriers should make good under the lighter, pneumatic-tire passenger vehicles. An 80 to 100-passenger bus would cancel largely one of the chief advantages of the bus, its ability to worm out of traffic jams, and also its opportunity to make somewhat better schedule speeds than the street car because of fewer stops.

If the very wide experience of Great Britain is to be taken as a guide, the motor bus will not replace the street car, but will supplement it and prove an incentive toward giving better transit over rails. The most desirable consummation, as we have hinted, would be for one management to handle the mass transportation of the community as a whole, regardless of the means of transit used.

Paving of Streets and Aisles, Brooklyn Army Supply Base

Types Suit Traffic and Construction Conditions—Granite Used for Heavy Traffic, Asphalt Blocks for Medium and Special Construction, and Bitulithic for Light Traffic

PAVING on the streets and aisles of the South Brooklyn Army supply base was of three kinds, designed to suit the different traffic and construction conditions. The main streets were paved with granite block, the open park betwen the building and the dock line, known as the "farm," with bitulithic, the piers with asphalt block and the traffic aisles in the buildings with thin asphalt block. The peculiar drainage conditions on the main streets made it necessary to adopt special sections for the granite street, while the speed with which the work had to be done required winter work and special plans for handling materials.

Expediency as well as adaptability figured in the selection of paving materials for the various sections of the work. It was hard to obtain rail deliveries, and where possible water delivery was used. For instance, it was possible to bring in the asphalt block by all-water route from the plant to the dock floors. This was one of the determining features, aside from those given below.

Referring to the paving plan, Fig. 1, it will be seen that First Ave. and the heavy trucking streets around

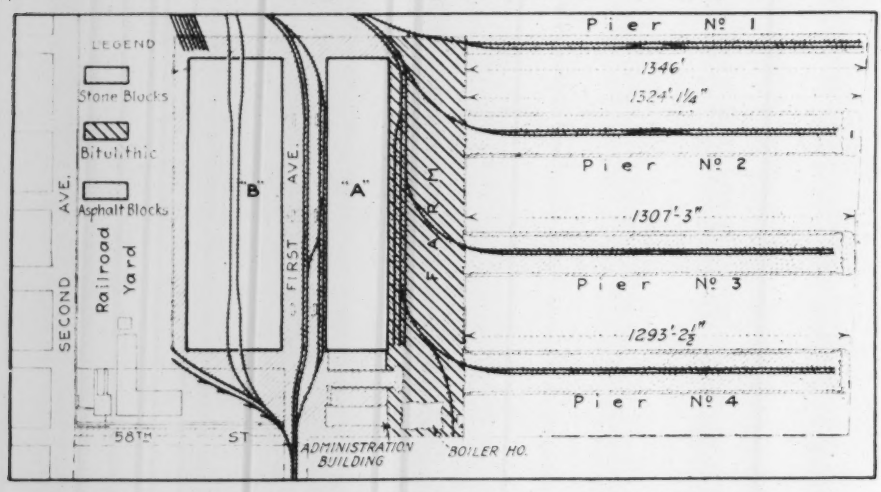


FIG. 1. LOCATION PLAN OF VARIOUS TYPES OF PAVEMENT AT ARMY BASE

the warehouses and along the hauling platforms were paved with granite block. This material was also used on one-half of 58th St., extending from First Ave. to Second Ave. Heavy types of Army motor trucks operate over these streets. When the job is completed, 47,000 sq.yd. of granite will have been used.

Standard New York specifications are being used in laying the blocks, which are 5½ in. deep except in the car tracks, where they are 4 in. on a 1-in. sand cushion. A 2-in. sand cushion is used on the regular work. The base consists of 6 in. of 1:3:5 concrete and, after the blocks are laid they are grouted with portland cement grout in a proportion of 1 of cement to 1 of sand. In the car tracks the blocks next to the rail are specially grooved to give clearance to the wheel flanges, as a T-rail is used instead of a girder rail.

A departure from the usual custom is seen in the use of cross expansion joints every 50 ft., in addition to the longitudinal expansion along the curb and between the pavement and building walls. That there might be no delay when the job started, the blocks were delivered some time before the work of laying started. They were piled in the yard by means of a clam-bucket locomotive crane which unloaded them from the cars and deposited them upon the piles. When they were required, they were loaded on trucks by means of a steam shovel.

While it would seem that such treatment is severe, and that there would be a great amount of chipping due to handling with the clam and the steam shovel, visual inspection does not indicate that the blocks were injured to any extent. The pile of blocks and the steam shovel may be seen in Fig. 2. By this method of delivery and piling it was possible to have the blocks all on the job when required, in spite of the bad transportation conditions during the war period. All through the Army base construction this principle of piling an adequate storage to counteract difficult transportation conditions was followed. The granite block used upon this contract are being laid by the Asphalt Construction Co. of New York, under a subcontract.

Drainage—The surface drainage at the Army base is taken care of mainly on the through heavy-traffic streets. The profile, Fig. 3, (see next page) in connection with the plan, shows the general details of this drainage. The main streets were dished at the center to keep the water away from the car tracks and loading platforms along the buildings as much as possible, and, to carry off the water, catchbasins were placed at frequent intervals, about 80 ft. apart, so as not to require much variation in the center line grade.

As the streets are practically level, it was necessary to use great care to obtain this drainage without either causing a wavy appearance of the street or having puddles of water standing upon the surface. Construction of a section of the pavement is shown in Fig. 4.

Construction—The methods used in the construction of the granite-block streets were not out of the ordinary. However, the subgrade conditions caused considerable worry to the engineers and contractors. This was particularly the case on First Ave., which had ex-

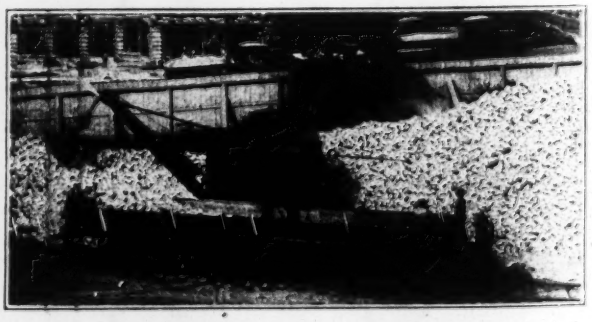


FIG. 2. HANDLING GRANITE BLOCKS BY MEANS OF STEAM SHOVEL—VERY LITTLE CHIPPING OCCURRED

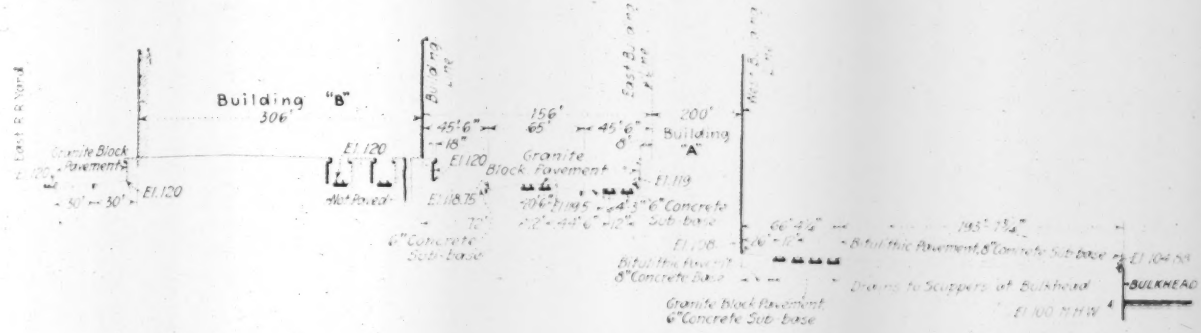


FIG. 3. PROFILE OF SITE, SHOWING METHOD OF HANDLING DRAINAGE AT BROOKLYN ARMY SUPPLY BASE. NOTE THAT STREETS ARE DISHED AT THE CENTER

tensive excavations to a depth of from 5 to 26 ft. extending across the street and along the edges of the buildings. It was not possible to permit these excavations to settle for a long time before the pavement was constructed, and it was necessary to use great care in backfilling and puddling in the material. This was done in thin layers which were either thoroughly

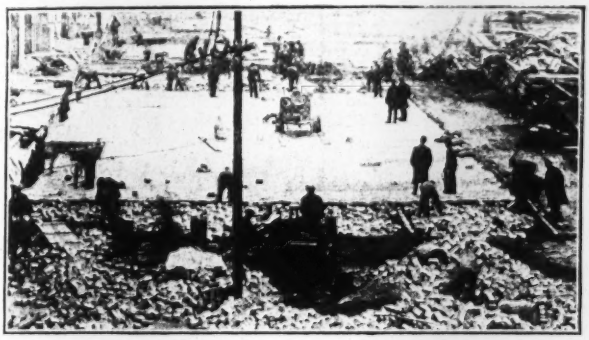


FIG. 4. GRANITE PAVEMENT AT ARMY BASE HAD TO BE CONSTRUCTED IN SHORT SECTIONS

tamped or puddled with water. To the present time no settlements are apparent.

While such unstable subgrade conditions might seem to dictate another form of construction, it was decided to put in the usual heavy concrete base and a grouted granite surface. This was done inasmuch as the subgrade is largely of sand, which, it is thought, will not settle much after being carefully backfilled. Another precaution was the putting of scrap-iron reinforcement over the deep cuts.

The piecemeal methods which it was necessary to use in constructing the pavement—due to the great number of different kinds of construction going on in the street at the same time in putting in subways and overhead bridges from building to building—made impossible an economical management of the work. Therefore, cost data would be of little value. The base was laid in sections where it was possible to work without interfering with other construction, and the cushion and the granite surface were laid and grouted in the usual manner. Neither the monolithic construction nor the semimonolithic construction using a cement sand bed was used upon the granite paving of this work. The grout filler was deposited on most of the work with a small mixer and was covered with straw to protect it from the frost. Fig. 5 shows the completed pavement on First Ave., with the bridges and location of the underground tunnels which extend across directly under the archways.

Where traffic is medium and where there are special construction requirements, asphalt block is used for the surfacing. It is used on the lower floor of the four steamship piers, and in one case on the upper deck at the entrance of the pier. Block of a different thickness was used in a large number of the traffic aisles throughout the buildings. Two different styles of asphalt block were used upon the job. One size was 5 x 12 x 2 in. and was used for the heavy-traffic construction upon the piers and on some of the street work, and on the bridges running from the piers to the warehouses. They were also used on the loading platforms around the two large warehouses, A and B, shown on the plan. The second style of block was 4 x 8 x 1½ in. and was used in the traffic aisles and around the elevators on the third floors of both warehouses and in the traffic aisles of the basement of warehouse B.

One of the illustrations, Fig. 6, shows the floor as laid on the piers. These piers are 1300 ft. long by 150 ft. wide, and have double car tracks running their entire length. Motor trucks are used upon the floors adjacent to the tracks and run out from the piers to deliver goods to the various warehouses. These piers are entirely founded upon piles capped with concrete, upon which the superstructure is built. It was thought that the asphalt block would be less liable to crack and show up badly if there should be any settlement or heavy vibration of the piers due to bumping by steamships.

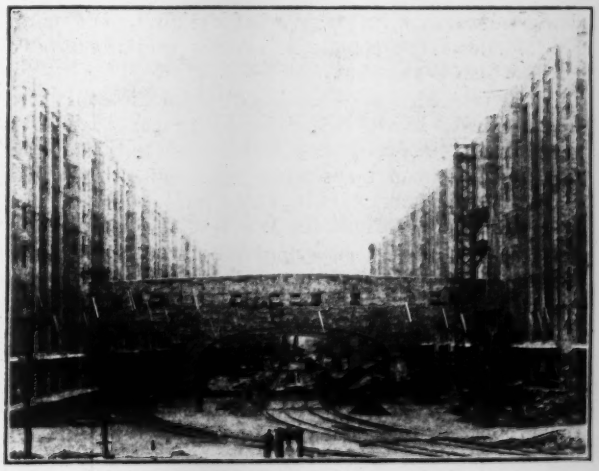


FIG. 5. VIEW OF FIRST AVENUE AND ARCHWAYS WHICH INTERFERED WITH PAVEMENT WORK

The same consideration did not affect the upper floors of the piers, as this vibration would naturally be relieved by the resiliency of the steel work. Of the large blocks 81,000 sq.yd. were used, while 23,000 sq.yd. of the

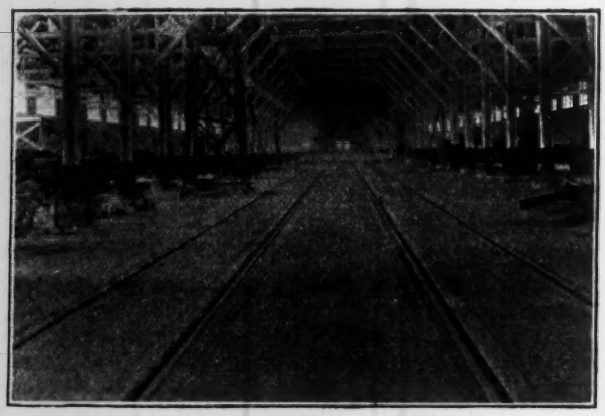


FIG. 6. ASPHALT BLOCK PAVEMENT ON PIERS. NOTE HEAVY MOTOR TRUCKS AT SIDES

thin blocks were used in the other work. The blocks were furnished and laid by the Hastings Pavement Co., of Hastings-on-the-Hudson, N. Y.

Each size of block was specially made and proportioned to fit the service for which it was to be used, special formulas being used for the composition of the blocks. They were delivered to the work by boat, and special apparatus was used to facilitate handling. The methods used in handling are described in the columns of this issue devoted to "Hints to the Contractor."

Construction—Specifications of the most approved type were used in laying these blocks. A very smooth concrete base was required, and the blocks were laid on ½ in. of 1:3 mortar mixed with just sufficient water to permit the cement to set. This mortar bed was struck to a true and even surface by means of a light I-beam straight-edge, traveling over two rows of steel strips which were set to conform to the desired surface grade. The blocks, being uniform in depth, were laid with close joints, and required no rolling other than slight ramming as they were being set. After being laid the 2-in. blocks received a light coat of sharp, fine sand, which was thoroughly broomed into the joints. Fig. 6 shows the completed surface and the type of traffic which it sustains.

In the traffic aisles of the building, on the floors mentioned above, it was not thought proper to use the plain concrete floor. It was found that the tractors and trailers used upon these floors were quite destructive, due to the cast-steel wheels, which had a ridge running around at the center of the tread. This caused heavy concentration at the center, and tended to cut up the concrete pavement. For this reason it was thought wise to substitute the asphalt block in some of these aisles, the thinner blocks being used.

Laying proceeded practically as with the 2-in. depth, except that, instead of filling the joints between the blocks with sand, they were filled with cement grout, the proportion being about 1 of cement and 1 of very fine sand, mixed thin with water. This construction was used because it allowed traffic upon the blocks much sooner than when they were filled with sand, as the grout stiffened up the construction. The traffic upon these aisles is largely composed of electric tractors with trailers.

Construction for Light Traffic—Besides the two types of construction mentioned, there was the paving used upon the open area between warehouse A and the bulkhead which is known as the "farm." This entire area was covered with a bitulithic surface. The basement floor of warehouse A received a similar construction. The "farm" area required about 26,000 sq.yd. of paving, while the lower floor of warehouse A required about 14,000 square yards.

Very little heavy traffic is contemplated on the "farm" area; it is expected that electric tractors with trailers will do the hauling.

Plans—The plans for this work call for an 8-in. concrete base with a regular 2-in. bitulithic surface laid according to the Warren Bros. standard specifications. The section shown in connection with the plan shows the method of drainage, which is from the building, A, directly to the bulkhead line, the pavement having a continuous slope and draining through scuppers at the bulkhead. Fig. 7 shows the plan of this area, together with the piers and the construction plant which was installed to take care of the work.

Construction—A complete, portable asphalt plant was deemed necessary to carry on this work properly. It was installed near the bulkhead, and materials were delivered, heated and mixed at the site, and delivered by motor trucks to the pavement surface. Compaction of the surface was secured by the use of a 10-ton roller, after which the surface received a squeegee coat. A general view of the asphalt plant is given in the cut.

The work is being done by the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the construction division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Major J. W. Cerny

FIG. 7. SPECIAL ASPHALT PLANT USED IN LAYING BITULITHIC PAVEMENT

is directly in charge of the part of the work described. The general contractor is the Turner Construction Co., New York, and the paving was done by subcontract as noted in the text.

Co-Author of Article

The name of the co-author of the article, "Sewage-Treatment Works at Langley Field, Virginia," in *Engineering News-Record* of Aug. 21, 1919, p. 374, should have been given as Carl L. Weir instead of Carl L. Weil.

Amendments to St. Louis Zoning Ordinance Passed

By Harland Bartholomew
Engineer, City Plan Commission, St. Louis, Mo.

AFTER a year of successful experience with the new zoning ordinance, the City Plan Commission of St. Louis, Mo., recommended to the Board of Aldermen several amendments which experience had proved desirable. Three of these amendments have been passed by the board. The principal change was made to meet the objection to providing rear yards on all properties in the high-value commercial district. Under the new amendment, the rear-yard provision of 2 in. in depth for each foot of building height is retained, but where a builder wishes to depart from this provision he may do so by providing somewhat greater open spaces in the form of yards or courts elsewhere on his lot. The text of the amendment is as follows:

The provisions for rear yards, heretofore provided, may be waived as to buildings to be used for hotel, industrial or commercial purposes providing for courts or yards, open to the sky, having the following percentages of lot area for the several districts: "A" district, 15% of the lot area on an interior lot above the first story; "B" district, 10% of the lot area above the first story on corner lots and 20% of the lot area above the first story on interior lots; "C" district, 25% of the area of the lot above the first story.

The second amendment applies to the area regulations. It reduces slightly the required depth of rear yards for apartment houses, and increases the width of side yards and inclosed courts. The rear-yard requirements are reduced from 4 to 2½ in. for each foot of building height, and the side-yard requirement is increased from 1½ to 2½ in. in width for each foot of building height, and the outer court requirement is increased from 1½ to 3 in. for each foot of building height.

New Provisions Are Satisfactory

Inasmuch as the majority of the residents live on the sides rather than at the rear of the apartment houses, as constructed in St. Louis, the new provisions are much more satisfactory. Furthermore, considerable confusion arose as to which were side and which rear yards for large apartment houses built on corner lots. By equalizing the widths of both rear and side yards, the confusion is avoided. The text of this amendment is as follows:

A tenement or apartment house in the "B," "C" or "D" area district exceeding 30 ft. in height shall have a rear yard 2½ in. deep for each foot of building height; when side yards are provided, they shall be 2½ in. wide for each foot of building height; and when outer courts are provided, they shall be 3 in. wide for each foot of building height.

The third amendment exempts theaters, motion-picture houses, clubs, auditoriums, places of amusement or buildings intended to be used for casual occupancy only, or buildings used exclusively for storage or warehouse purposes, in the "A," "B" and "C" area districts, from area provisions, permitting these buildings to occupy 100% of the lot. The text of this amendment is as follows:

Any theater, motion-picture house, club, church, auditorium, place of amusement or building intended or used for casual occupancy only, or any building used exclusively for storage or warehouse purposes in the "A," "B" and "C" districts may occupy 100% of the area of the lot or plot.

Sunstroke and Lightning as Viewed by Compensation Commissions

By Chesla C. Sherlock
Des Moines, Iowa

IF A workman engaged at work on a dam or on an irrigation project or bridge suffers a sunstroke, is he entitled to compensation? This is a question which has been settled in the affirmative after a great deal of controversy.

It was urged that sunstroke was not an accident arising out of the employment, because it was a hazard suffered by all in the community; that the man who happens to be in the vicinity is just as likely to suffer sunstroke as the man at work. The courts seemed to favor this view, and have quite generally held that sunstroke is not a compensable accident. But the Iowa Industrial Commissioner has said: "Sunstroke, in order to be compensable, must be the result of extraordinary conditions not common to the requirements of ordinary service. A workman who succumbs to heat while exposed only to the hazard of laborers of his community generally on a hot day should not be encouraged to move for compensation allowance. On the other hand, a workman who is stricken in the performance of duty in which unusual heat exposure is involved, exposure not common to the laborers of the community in general, is apt to be well within the limits of compensable injury."

Finally, the courts have concluded that if the employment increases the hazard from sunstroke so that it is greater than the hazard common to everybody in the community, then the workman suffering a stroke may recover compensation.

As to whether lightning is an accident or not, there does not seem to be much contention. The Wisconsin commission has said:

"Lightning stroke is not popularly spoken of as an accident where it comes from the action of the elements without the agency of man. When the agency (industry) through the agency of man combines with the elements and produces injury to the employee by lightning stroke, it may well be said that the injury grows out of the employment and is accidental."

In a Minnesota case it was said: "If the deceased was exposed to injury from lightning by reason of his employment, something more than the normal risk to which all are subject, if his employment naturally accentuated the natural hazard from lightning and the accident was natural to the employment, though unexpected or unusual, then a finding is sustained that the accident from lightning was one 'arising out of the employment.'"

Deepest Mine Is Shaft of Michigan Tamarack

According to the United States Geological Survey, shaft 3 of the Tamarack mine, Houghton County, Michigan, is the deepest mine in the world, with a depth of 5200 ft. Other shafts of the Tamarack and of the Calumet and Hecla mine in the Lake Superior region reach depths of between 4000 and 5000 ft. Three shafts of the Prizbram silver mines, Austria, have penetrated to depths of 3300 ft. The Victoria quartz mine, at Bendigo, Australia, is 4300 ft. deep, and a number of shafts in the Transvaal gold region have been sunk to depths of nearly 4000 feet.

Correcting Steel-Tape Readings for Sag and Stretch

Charts Diminish Labor in Computing Corrections—Working Pull Should Equal 2000 Times Weight of One Foot of Tape

By Walter S. Weeks
Associate Professor of Mining, University of California, Berkeley, Calif.

THE correction of measurements by the steel tape for sag and stretch is usually a tedious process. A greater part of the work may be eliminated by using a pull which is always a definite multiple of the weight of 1 ft. of tape, and plotting a correction curve that applies when this pull is used. Charts may then be made, as in Figs. 1 and 2, from which these corrections may be read directly.

The pull that I have selected is 2000 times the weight of 1 ft. of tape. This I call the "working pull." The pull should be exerted at the upper end of an inclined tape. The operation of using this definite pull may be simplified by placing a stop or collar on the spring-balance at the proper mark.

Referring to Fig. 1, the horizontal figures show the length of the tape in use. The vertical figures at the left show the correction in feet. Any ordinate of the straight line marked "Stretch" is the amount that the tape stretches for the length in use.

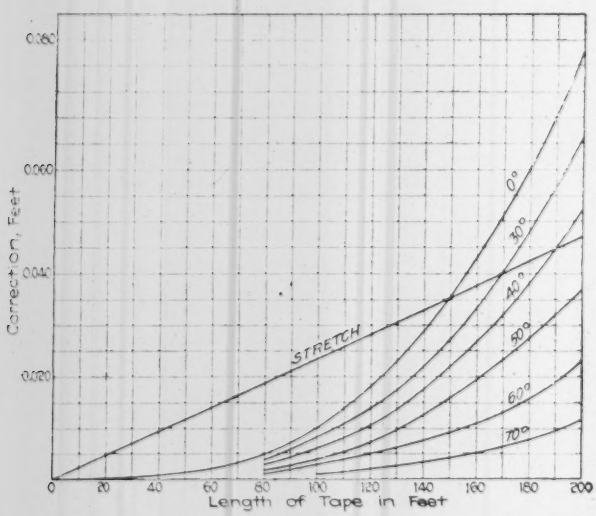


FIG. 1. STEEL TAPE CORRECTIONS FOR STRETCH AND SAG AT VARIOUS INCLINATIONS

A tape, supported at the ends only, of course hangs in a curve. Any ordinate of one of the curved lines on the chart is the difference between the length of the arc and the chord between the two ends. The different curves on the chart are for different angles of inclination. The angle of inclination is designated at the right-hand end of each line.

Let us suppose we are measuring the distance horizontally between two points and the tape reads 100.0 feet. What is the true distance?

From the chart, the tape has stretched 0.0234, so that the true distance along the arc of the tape is 100.0 + 0.0234 = 100.0234. The distance we want is along the chord. From the chart, the ordinate of the 0° sag curve at 100 feet is 0.01, so the true distance along the chord between the two points is 100.0234 — 0.01 = 100.0134.

The stretch correction and the sag correction are always in opposite direction, so all we really have to do is to measure the distance between the two lines. Place one point of a pair of dividers on the intersection of the feet line with the sag line, and the other point on the intersection of the stretch line and the feet line. Transfer this distance to the scale at the left where the correction is read in feet.

If the stretch line is above the sag line, the tape is virtually too long; and if the sag line is above the stretch line the tape is virtually too short. If we are measuring the distance between two points and the tape is too long, we have read too little, so the correction must be added. If the tape is too short we have read too much, so the correction must be subtracted.

If we are laying out a line of definite length, if our tape is too long it is evident that we must subtract the correction to find the point where the tape must be held. The opposite is true if the tape is too short.

Fig. 2 is a chart which is a more simple expression of the combined corrections for a horizontal tape. Any ordinate of this curve gives the combined corrections of sag and stretch. It is almost as simple to include in our corrections the changes in length due to variations in temperature, and to include the factors entering into the standardization of the tape.

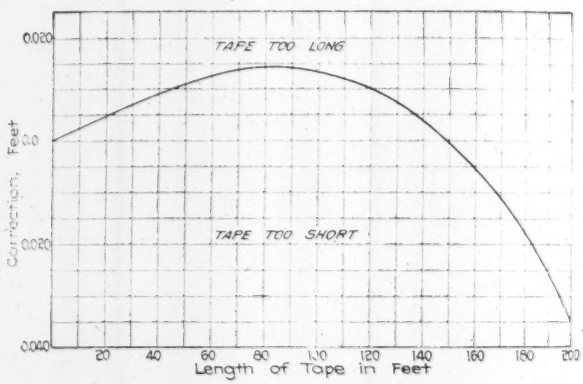


FIG. 2. COMBINED CORRECTIONS FOR STRETCH AND SAG FOR LEVEL MEASUREMENTS

Such a chart is printed in the University of California "Publications in Engineering" in a paper entitled "A Graphical Method for the Correction of Steel Tapes," by the writer. The paper also contains a discussion of the theory on which the present charts are based. It may be obtained by sending 10c. to the manager of the University Press, Berkeley, Calif.

A chart for correcting steel tapes from 200 to 500 ft. can be found in the *Mining and Scientific Press*, of May 19, 1917, Vol. 114, p. 703.

The charts here published apply only when a pull is exerted on the tape which is 2000 times the weight of 1 ft. of tape. I selected this factor to keep the combined error due to sag and stretch as small as possible. If the surveyor makes a practice of using this pull he will be able to correct his measurements at a glance, and, if he does not care to correct them, he can feel sure that with any tape up to 200 ft. he will have an error due to sag and stretch not greater than 1 part in 4000.

Engineers Protest to President Against Plumb Plan

Council of the American Institute of Consulting Engineers Points Out the Economic Fallacies in the Proposals of the Railway Brotherhoods—Wages Have Advanced Faster Than Living Costs

The following statement, which is quoted in full, has been addressed to the President of the United States by the Council of the American Institute of Consulting Engineers, Aug. 19, 1919, over the signatures of Lewis B. Stillwell, president of the institute, and F. A. Molitor, secretary.—EDITOR.

THE Council of the American Institute of Consulting Engineers has given much consideration to the statement appearing in the public press on Aug. 3, 1919, signed by the executive heads of the Brotherhoods of Locomotive Engineers, Railway Trainmen, Locomotive Firemen and Enginemen, and the Order of Railway Conductors, respectively, and also by the president of the railway department, American Federation of Labor.

In view of the coercive and somewhat threatening tone of this statement, and the fallacies in the economic arguments presented in it, the council feels impelled by a sense of public duty to address you upon the subject, and to file copies of this communication with the committees of interstate commerce of the two houses of Congress.

This institute fairly represents the thought and sentiments of the civil engineering profession which has played such an important part in the development of our railway systems—a profession which has been the pioneer in the location and construction of the railways and has taken a progressive and leading part in their scientific operation. In view of these facts, we feel that our analysis of the statement of the brotherhoods merits full consideration.

The statement contains an argument for an increase of wages for the railway employees as a privileged class and a plea for a somewhat startling solution of the railroad problem, in that the latter contemplates Government ownership of the railroads with management in which the brotherhoods practically dominate.

1. The statement is made that "labor faces a persistently serious situation due to the cost of living and the impossibility of wages keeping pace with the depreciation of money." We suggest in answer that railroad labor does *not* face any more serious situation than that which confronts the average American citizen, especially the clerical and professional classes and the majority of investors, most of whom are, indeed, suffering more severely than railroad labor.

2. The statement is made that "the railroad employees are in no mood to brook the return of the lines to their former control." The natural inference formed from this coercive language is that the railroad employee has forgotten the vested property rights guaranteed by our Constitution, as well as the relation which the transportation system of the country bears to the interests of the general public.

3. The statement is made that " . . . inflated profits and the cost of goods mount faster than the wage level. A few grow wealthy and the multitude is impoverished." We will show later from statistics that this is an erroneous statement. It is a matter of common knowledge that the many are less impoverished today than in any other period of our country's history. At no time has railroad labor enjoyed more of the luxuries of life than now.

4. The statement further adds, "not only have we suffered from inadequate wages, but the public has paid an extortionate tax for transportation, a tax based on inflated values. . . ." Our search of available statistics reveals the following as an answer to the foregoing quotation:

MONTHLY WAGES PER MAN OF ALL RAILWAY LABOR

1916	$75 00
1917	90 00
1918	110 00
1919	125 00

The average wage paid is now such that any further and material general increase cannot be justified unless it is to be assumed that railway labor is entitled to preferential treatment as compared to workers in other fields.

It is stated that the average increase of wages paid the members of the four railroad brotherhoods since 1916 has amounted to about $800 per annum, an increase of more than 60%. In addition to previously granted increases in wages, the press states that requests for further increases, now in process of formulation but not officially presented, will, in the instance of the four brotherhoods, amount to, approximately, $300,000,000 per annum, and that the requests of other units of railroad workers who have already asked increases, and those who are preparing to do so, will amount to an additional $500,000,000 per annum, or a total of $800,000,000 per annum—a startling amount in the face of existing deficits of railroad operating income.

During the periods named, rates have averaged as follows:

REVENUE PER PASSENGER PER MILE (CENTS)

1916	1917	1918
2.04	2.09	2.60

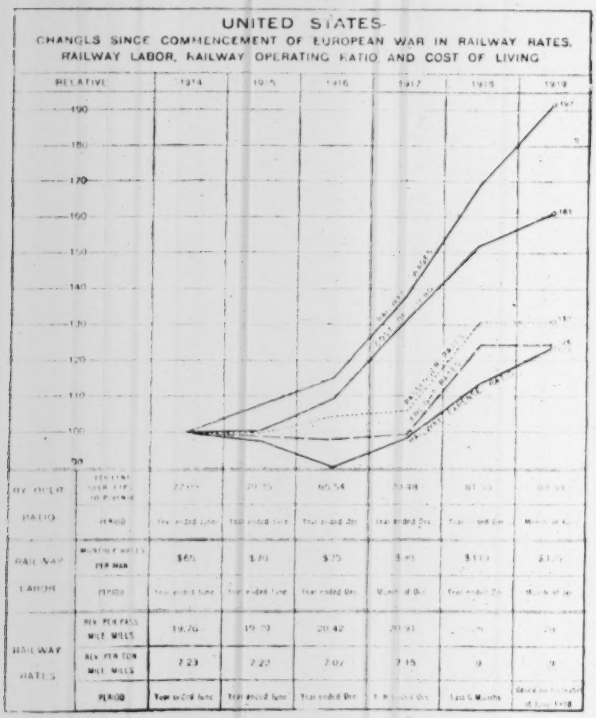
REVENUE PER TON PER MILE (MILLS)

7.07	7.15	9.0
Increase,	1%	26%

These rates, compared with those which obtain elsewhere, show that our people enjoy a much lower charge for freight than any other country in the world, and the statement that our rates for transportation are extortionate is not justified.

The figures for 1918 given above also reflect the increase of passenger and freight rates made under Government operation to meet the increased payrolls, and the Director General of Railroads has recently stated that these increased rates are not sufficient to meet the existing railroad payrolls, and that a further increase of, approximately, 10% will be needed to offset the continued deficits of operation.

We respectfully suggest that the above figures refute the statement of the brotherhoods that they are suffering from inadequate wages. Our investigations show that railway wages have increased faster than the cost of living, which is contrary to the statements made by the brotherhoods. The cost of living from 1914 to March, 1919, has increased 61%, whereas all railway wages have increased 92%. We respectfully invite your attention to an accompanying diagram which graphically shows the trend of railway wages, rates, and the cost of living. [See next page.]



RAILROAD WAGES HAVE INCREASED FASTER THAN LIVING COSTS

Authorities, "Cost of Living," reports of National Industrial Conference Board. Other data: Reports of Interstate Commerce Commission and United States Railroad Administration. The above figures are to March, 1919. Advance figures of "cost of living" to July, 1919, show an increase of 70.8 per cent.

5. Mention is made of "the railroad profiteers . . . of Wall Street." This is a generality that hardly needs refutation but is, however, deserving of criticism.

In 1916 there were 30,706 miles of railroads in the hands of receivers, showing to what low ebb railroad credit had sunk, and the consequent financial condition of the alleged "profiteers." Statistics show that the great bulk of railroad securities is not held in "Wall Street," as the term is commonly used. On the contrary, there are no securities of our commonwealth more broadly held by our people than our railroad securities, excepting war issues of Government bonds. There are, approximately, 700,000 stockholders of our railroads whose holdings average about $13,000 par per stockholder. From the records obtainable in respect to the distribution of railroad bonds, we find that the savings banks of our country own about $1,214,000,000 and the other banks about $472,000,000, making a total of $1,686,000,000. There are more than 11,000,000 depositors in the savings banks who are directly interested in those bonds, because their savings have been invested in them. In addition, our insurance companies hold bonds of about $1,520,000,000, and there are 34,000,000 insurance policyholders whose policies are in no small measure secured by these investments. As there are, according to the last published report of the Interstate Commerce Commission, about $10,000,000,000 worth of railroad bonds in the hands of the public, then $3,206,000,000, or 32%, of them are held by insurance companies and banks in which the public has a direct and personal interest.

Another point of public interest, it seems to us, is the fact that the four brotherhoods have, according to the American Federation of Labor, a membership of 480,000, all of whom are not, however, employed upon the railroads. According to the last Interstate Commerce Commission report, about 322,000 trainmen are engaged upon the steam railroads, as compared with a total number of all railroad employees of 1,800,000. It is, therefore, plainly seen that the powerful and well organized labor organizations which bespeak your consideration and that of Congress in favor of their solution of the railroad problem, and their threatening demands in respect to an immediate increase in wages, comprise only about 18% of all the railroad workers. For your consideration, and to show that the railroad workers are a comparatively small proportion of our total citizenry engaged in gainful pursuits, we submit the following from the latest census reports:

Occupation	Male Employees of All Ages
Agricultural pursuits	14,777,000
Mining and minerals	1,109,000
Manufacturing industries	11,484,000
Transportation, all classes	3,264,000
Trade	4,156,000
Public service	528,000
Professional service	1,912,000
Domestic and personal service	4,285,000
Clerical	1,938,000
Miscellaneous	750,000
Total	43,206,000

Note: 100 units ignored

The percentage of all males in the transportation service (including trolley lines and other means of transportation) is 7.7% of the total, those engaged on steam railroads 4.2% of the total, and the members of the brotherhoods only eight-tenths of 1% of the total males engaged in gainful pursuits. It is the larger percentage for whom we bespeak your consideration.

6. The statement is also made that "the cost of capital would be reduced from the present 6 to 7% paid to Wall Street to 4% paid upon Government securities."

This we affirm to be a serious misstatement. The last report of the Interstate Commerce Commission shows that the average annual interest rate on the total bonds outstanding against the railroads of this country was 4.9%, and upon the stock of our railroads but 3.91%, so that the statement in respect of the 7% as the cost of capital employed is entirely erroneous and misleading.

The rate of interest on our Government bonds prior to our entry into the war was indeed less than the interest paid upon the railroad securities, due in part to privileges enjoyed by the holders of Government securities which are accepted as security for notes issued, deposits, reserves, etc. It is significant that the last loan, popularly called the Victory Loan, carried an interest rate of 4¾%. Our net public debt on Apr. 1, 1917, was $1,207,827,886, a per capita debt of $11.59. On May 31, 1919, the total gross debt was $25,921,151,273.75, or about twenty times greater, making a per capita debt of about $230. It is believed that the valuation of the railroads has progressed at least far enough to enable us to estimate that any fair valuation of the railroads of our country will approximate $18,000,000,000. Should the Government either assume this obligation or take over the railroads as suggested by the brotherhoods, it follows that the Government credit will be extended to the amount of $18,000,000,000, and we

feel assured this amount of additional capital will not be available at less than a 5% interest rate. Furthermore, the increase of the public debt would depress the value of the war loan held by millions of our patriotic people.

While the whole problem of our transportation system is under consideration, we suggest the scrutiny of all legislative restrictions which have been imposed upon the railroads and which have led to increased operating charges without compensating advantages to the public. A specific case in point is what is commonly termed the "full-crew law."

We feel that the remedy for the present high cost of living rests not in increased wages, but in increased production, which largely rests in the hand of labor, in that increased efficiency and energy on their part will stimulate the output, resulting in increased output per unit. Recent inquiries and searches have revealed the fact that the output per unit has been decreasing in late years, coincidently with the increase in wages and shorter hours and, consequently, until this is corrected by greater individual industry, living costs cannot become normal.

We commend and indorse your recent remarks that strikes and labor unrest retard production in general and increase the cost of all commodities, and we believe that your continued influence in this direction will result in better labor discipline, without which efficiency is impossible.

We hope we have advanced a sufficient answer to the demands of the brotherhoods to show the fallacy of their arguments and the unstable economic foundation of their proposed solution of the railroad problem. We plead for a fair and comprehensive investigation of the subject of increased wages. We feel that any increase of railroad wages should be considered with the greatest caution, being mindful of the conditions reflected in the above statistics. We remember that all classes of our people are confronted with the same conditions as the railroad brotherhoods and that they are considering the subject with patience and a mutual understanding that should suggest to the brotherhoods an equal consideration of the public good. In so far as the plan proposed by the railroad brotherhoods for the solution of the difficult railroad problem is concerned, we hope that you will use your great influence against it and urge some other plan which is based upon sound economic policy.

St. Paul Municipal Bank After Six Years' Work

After six years of operation, the "municipal savings bank" of the City of St. Paul, Minn., described in *Engineering News-Record* of Nov. 8, 1917, p. 878, had deposits totalling $3,635,000 on July 1, 1919. The "bank" is operated by one clerk. It accepts deposits and issues 4% certificates redeemable on demand and with interest, whether the money has been on deposit a day or a year. For the investment of its deposits the "bank" buys tax certificates and bonds of the City of St. Paul, particularly at times when the city would have to pay high rates for loans through commercial channels. Within the past 12 months the "city bank" has taken $100,000 of 4½ per cent. 30-year water bonds, $600,000 of 4½ per cent. school bonds and $750,000 of 5 per cent. tax levy certificates, which, it is stated, were not commercially marketable at those rates. It is reported that the water-bond transaction alone will save the city $105,000 of interest charges.

Main-Route Highway Construction in New Jersey

Work on the Route Between Jersey City and Philadelphia of Heavy-Slab Type—Drainage Main Feature—Convict Labor on One Section

CONSTRUCTION of the main route between Jersey City and Philadelphia by the New Jersey Highway Commission is of a most substantial type, being designed for the heaviest motor traffic. Proper drainage is a main consideration, and this is uncommonly complete. It is designed in such a way as to make it more or less accessible, while every precaution is taken to prevent it from becoming clogged and ineffective. The work is largely let by contract, but on one section the state is doing the work by convict labor.

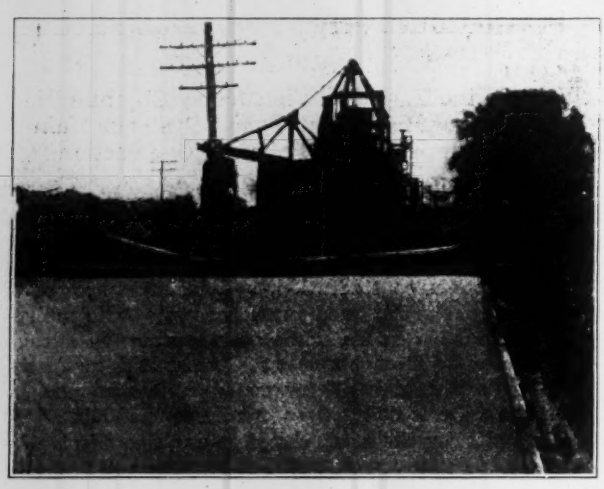
In designing the road, the Highway Commission has aimed to provide for the heaviest traffic expected for the next twenty-five years. The slab is 18 ft. wide, 10½ in. at the center, and 8 in. at the side. Reinforcement, however, is not provided. The concrete mixture is 1:2:3, and is laid directly on top of an old macadam foundation, in all places where it has not been necessary to remove the latter to obtain a better grade.

As stated, one of the items of design concerning which the department is very particular is drainage. Wherever the soil is of a nature to drain poorly, such as clay, herringbone drainage is placed under the surface, and in all cases drains are built along the edges of the slab. These drains are made of 8-in. vitrified tile in a large proportion of the work, and are built with lamp-holes every 300 ft. to provide for inspection in locating any stoppage. The construction of these lamp-holes is shown in the view herewith. The depth of trench below subgrade is 3 ft., or 3 ft. 10½ in. below finished grade. It is 18 in. at the bottom, and has the necessary side slope to stand well. A 1-in. plank is placed in the bottom of the trench. Upon this the tile is placed, and suitable cast-iron lamp-hole covers are provided at the top, as shown in the view.

DESIGN OF LAMP HOLES FOR TILE DRAINAGE

When the tile has been placed, crushed stone or slag is piled over the same to a depth of about 18 in., to facilitate drainage. To keep the earth from passing down through the stone and into the tile from above, a layer of about 3 to 4 in. of straw is placed on the top of the stone, between it and the earth filling. Although it had rained for a week preceding a recent inspection, the surface water had been taken care of so well that the subgrade was practically dry, and the contractor was able to resume work on the day after the rain.

A view on the next page shows the type of surface which is being obtained by the use of a Lakewood



SURFACE OBTAINED ON NEW JERSEY HIGHWAY BY USE OF MECHANICAL FINISHER

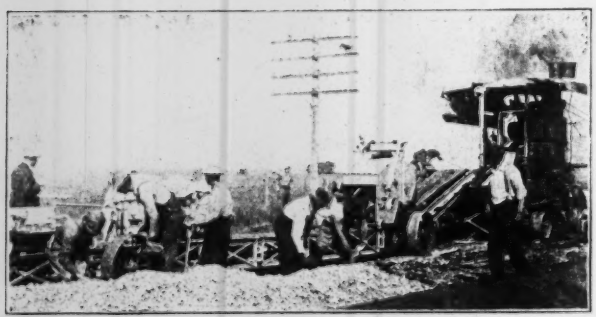
mechanical tamping machine with a belt finishing attachment at the rear.

The contract, which is known as Route 1, Sec. 4, is being executed by Hugh Nawn, of Philadelphia and Boston.

Convict labor is being used by the state on another section of the same highway known as Route 13, Sec. 4. This extends from Kingston to Franklin Park. While the same concrete section and proportions are being used, the work is being done by the tamping templet and belt finishing method The section is 18,370 ft. long.

Special equipment is used in connection with this convict work, in the form of a mixer loader, a view of which is shown. This loader eliminates the use of wheelbarrows, by giving leeway for the shoveler where the distribution of material is inaccurate.

It is reported that convict labor has worked very efficiently to date upon this contract. The Highway Department pays the Prison Board at the rate of $2 for eight hours. With a gang of 28 convicts, a superintendent, an inspection foreman, two finishers and a



MIXER LOADER AS USED ON NEW JERSEY CONVICT LABOR WORK

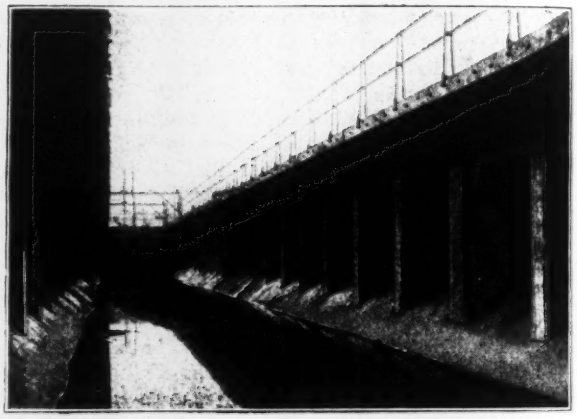
mixer man, 230 ft. of 18-ft. roadway, 10½ in. at the center, and 8 in. at the side, was completed July 24. The foreman stated that the gang should average about 200 ft. per day. The work is all under the supervision of H. G. Thompson state highway engineer. H. D. Robbins is division engineer and F. W. Conover is resident engineer.

Double-Track Water-Type Ashpit· Pennsylvania Railroad

Pit 300 Feet Long Built in 26 Days — Portable Concreting Plant—Ash-Handling Crane and Safety Devices

RAILWAY ashpits of the water-filled type are coming into rather extensive use, and a large reinforced-concrete ashpit of this type, capable of accommodating six of the largest Mallet locomotives, has been completed recently by the Pennsylvania R.R. in connection with the revision of its engine terminal facilities at Youngwood, Penn. The pit is 300 ft. long and has sloping sides, with a track carried over each side by reinforced-concrete piers and girders. Cantilever brackets on these girders support concrete slab platforms for the use of the men working on the pit side of the tracks when cleaning the ashpans of the locomotives. The design of this ashpit is shown by the accompanying views and drawings.

Special consideration has been given to the safety of the men working at the pit. Besides the hand railing along the edge of the platforms the open spaces between the rails of the pit tracks will be protected by lines of ¾-in. steel rods spaced 12 in. apart and laid parallel with the rails. In each track, at each end of the pit, is a sloping floor or deck between the rails, with bars placed across the open space at the bottom of



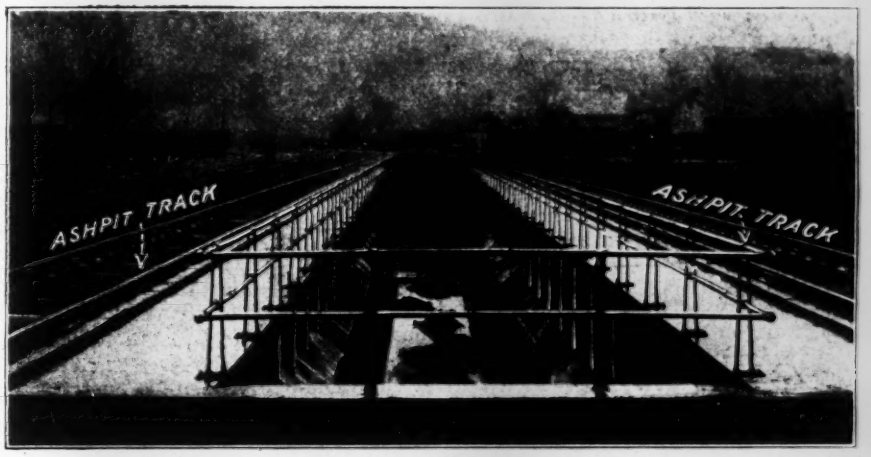
INTERIOR OF ASHPIT SHOWS CANTILEVER PLATFORMS FOR CLEANERS

the slope. This will warn men who may be walking between the rails at night or during heavy storms, and will prevent them from falling into the pit.

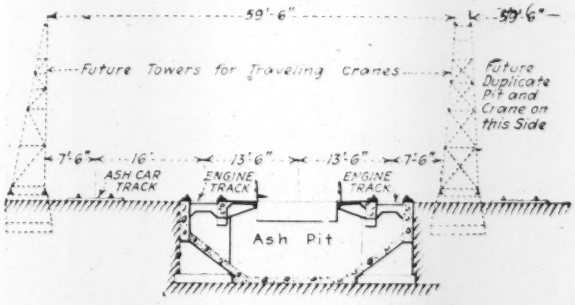
Removal of ashes from this pit is effected at present through the use of a grab bucket handled by a locomotive crane, this crane being operated on one or the other of the pit tracks during slack intervals. Eventually, however, an overhead traveling crane will be installed on an elevated runway extending the full length of the pits. The crane will have a span of 59½ ft., covering the two ashpit tracks and also a third track for the use of ash cars. Provision is made for a second ashpit parallel with the first one, and the towers on one side of the present pit will be of such shape as to carry two runways.

An average of 70 locomotives per 24 hours have their fires cleaned here and are concentrated on the pit in approximate intervals of six hours, so that the cleaning

operation must be done quickly in order that the engines may go onto the repair pits and be in readiness for service in the next period. Ashes are removed from the pit once a day at the most favorable interval. This work consumes about four hours and requires only one man, who, when not so employed, is engaged in other work about the engine terminal. A decided advantage claimed for this type of pit is its large capacity, since in case of labor shortage or failure of the ash-handling appliances the ashes could accumulate for three or four days without interfering with the work of cleaning fires. Rapid progress was made in the construction of this pit, 26 working days being required, from Nov. 28 to Dec. 24, 1918, although this was the period of greatest labor shortage. With a working force of about 120 men the average turnover was 28 men daily. Day and night shifts were worked most of this time. Although freezing weather occurred, it did not retard work on the pit or affect the strength of the concrete. On account of being depressed below the ground, the pit lent itself very readily to protective measures for preventing frosted concrete. A light framework was erected over the structure and covered with tarpaulins and tar paper, and salamanders were placed under this. After the concrete was poured, live steam was permitted to escape into the inclosure, to provide a moist heat which not only prevented freezing but assisted in thoroughly seasoning the concrete.



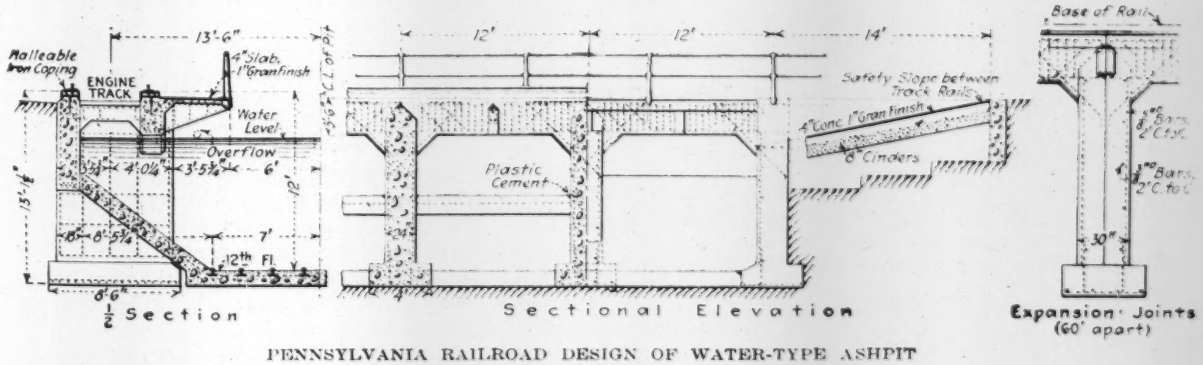
WATER-TYPE ASHPIT IN USE ON THE PENNSYLVANIA RAILROAD AT YOUNGWOOD, PENNSYLVANIA



LOCOMOTIVE ASHPIT WILL HAVE OVERHEAD CRANE FOR REMOVING ASHES

Excavation on the first 60-ft. length revealed a pocket of quaking gumbo entirely incapable of supporting the weight of the floor and its load of water and ashes. This gumbo was removed, the excavation having a depth of 18 ft. to bedrock. The piers were founded on this rock, and the excavation was backfilled to the level of the concrete floor, using granulated furnace slag thoroughly tamped. For the remaining portion of the pit the excavation was in hard and compact gravel, so hard, in fact, that blasting was necessary to loosen it sufficiently for its removal with a 1-yd. grab bucket operated by a stiff-leg derrick mounted on rails and moving on the center line of this structure. Excavation for the piers, however, was carried down through this gravel formation to bedrock. Water was encountered in the excavation work and was a source of considerable trouble, making it necessary to have a 10-in. centrifugal pump running day and night.

Pier footings, except for the first 60-ft. length, were poured in the excavations, without forms. All form work was of lumber. Concrete was made in the proportion of 1:2:4, using clean river sand and river gravel, the latter being known locally as pea gravel, the largest particle of which could pass through a ¾-in. screen. A portable concrete plant was rigged up, having a 1-yd. mixer and a 40-ft. steel tower mounted on a flat-car on a track paralleling the work, the concrete being distributed through chutes from this tower. No attempt was made to waterproof the pit, as the



PENNSYLVANIA RAILROAD DESIGN OF WATER-TYPE ASHPIT

groundwater level is about 3 ft. below rail level and the entrance of this outside water would reduce the amount necessary for filling. The seepage, however, is found to be trivial.

The work was under the direction of Robert Faries, division engineer, Pittsburgh division, and in direct charge of C. W. Richey, who is the assistant division engineer.

The contractor was J. Toner Barr, of Pittsburgh, Penn., with E. H. Gibson as his superintendent.

Steel Spur Dikes for Shore Protection

SPUR dikes composed of steel spider frames connected by wire strands are being used to check erosion of banks and foreshore along the Kaw River in Kansas. Each frame or spider consists of three angles 16 ft. long, secured together at the intersection and forming a structure that will stand in any position, while cables of wire are stretched between the ends of the angles.

When these frames or units are set in a row to form a spur dike they are connected by a horizontal cable which is tied to the center of each frame and has its shore end attached to an anchor. Sand, silt and drift

SPUR DIKES FOR SHORE PROTECTION HAVE STEEL SPIDER FRAMES

begin to accumulate around the legs of the frames, and in turn tend to increase the accumulation, while sand is deposited also in the still water beyond the dike until a protective foreshore is built up in front of the river bank.

Bridge abutments have been protected by one or two dikes, but when a long stretch of bank is to be protected there must be a series of them, generally about 200 ft. apart. The frames are assembled at the site. About 40 installations have been made. This device is the invention of J. W. Kellner, manager of the Patent Steel Jetty Co., Silver Lake, Kan.

Method for Estimating Storm-Water Run-Off

The name of the author of the article on "Graphical Method for Estimating Storm-Water Run-Off," printed in *Engineering News-Record* of Aug. 7, 1919, p. 282, should have been given as Ralph W. Horne, instead of Ralph W. Horner. In the second paragraph of the article, clause (3) should have ended with (2) instead of (1).

Protecting the Banks of Savannah River Through Augusta

Development of Methods Used and Data on Cost of Rock Face Revetment Placed in Pre-War and War Years

By E. C. Garvin

Brunswick, Ga.; Formerly Assistant Engineer, United States Engineer Department, Augusta, Ga.

BANK protection has been imperative on the Savannah River at Augusta, Ga., for many years. Above the city the river has a rock bottom and heavy slope. Augusta is situated at the very point where the slope of the river changes abruptly from a steep to a gradual incline. At and below Augusta the stream meanders through the coastal plain, where the banks are soft and easily eroded. At the upper end of the city front the river forms a sharp bend. During floods the current attacked the Georgia bank along the entire city front, which resulted in a loss of great quantities of material. The instability of this bank prevented proper terminal development for navigation and also precluded the construction of a levee which Augusta had been seriously considering since the freshet of 1908.

The earliest form of bank protection on this river consisted of spur dikes or "spurs" which extended out from the bank, approximately normal to the current, and formed a combination of shore protection and contraction works. The maintenance of these structures was costly. They soon became flanked by high-water erosion, necessitating extended revetment at the shore ends and frequent renewals of a complete protection work consisting of several dikes. The dike proper was built up of brush fascines each about 2 ft. in thickness, each fascine sunk in place with rock. Enough of these layers were used to bring the structure up to the desired height and grade, and the completed spur was crowned with a substantial layer of rock so that no brush was exposed on top. Several costly failures brought this form of protection into disfavor.

The spur design was superseded by a training wall, locally called a "dike," which follows closely the low-water line of the shore being protected. The design of this has undergone various modifications, dictated by experience, in an effort to attain an economical adjustment between original cost and annual maintenance. The dike proper consists of brush fascines placed between a double row of piles, tied together at the top, the brush being weighted down by a top layer of rock. The distance between the two rows is about 7 ft., the piles in the row next to the river are spaced about 6 ft. apart and in the row next to the bank about 8 ft. apart. The brush rests on the bed of the river and extends up to an elevation of about 4 ft. above low water, the top rock bringing the completed structure up to about 5 ft. above this datum. The protection work is thus a vertical wall about 7 ft. wide and from 5 to 20 ft. in height.

The dike is connected with the bank at intervals

varying from 50 to 200 ft. by breaks similar in design to the spurs previously described. These breaks are built on a uniform grade from the top of the dike to the crest of the bank or as near the crest as practicable. The purpose of the breaks is to deaden the current behind the dike and prevent flanking. In some cases a brush mattress, sunk with rock, is built from the dike towards the channel to prevent undermining. The ratio by volume from brush to rock for an entire protection work varies from 8:1 to 12:1. The pre-war cost varied from $5 to $10 per lin.ft. of bank protected. This form of protection has rendered satisfactory service where the river bend has a moderately flat curvature, but has failed completely at a few places where the bend is very sharp.

Along portions of the city front of Augusta the bedrock is within a few feet of the river bottom. This prevented the use of piles and precluded the longitudinal dike for bank protection. In addition to this, navigation and city interests demanded a form of protection having the utmost degree of permanence. A stone revetment was adopted and built. This consisted of a layer of broken stone spread on the roughly graded bank and covered with a layer of paving stone placed to form a more or less even pavement. The foot of the pavement was supported by a mass of rock, deposited in a dredged trench, the top of the trench rock coming up to about a foot above low water. The paving stone was well bonded with the trench rock against which it abutted. On the first two sections or contracts the pavement or revetment proper was carried up the bank to an elevation of 18 ft. above low water, which is about 8 ft. below the crest of the bank; on the third section the bank was paved to the crest. The area between the top of the pavement and the bank crest was graded, and sodded with Bermuda grass.

In its natural condition the bank was covered with bushes and small trees. In building this revetment the vegetation and the top soil were removed, marked irregularities were smoothed out, gullies were filled and the entire area to be paved was roughly graded to conform to the natural slope which the river had carved for itself, except that no slope was allowed steeper than 1½ horizontal to 1 vertical. The trench was excavated along easy lines following closely the low-water contour.

REVETMENT COMPLETED TO 18 FT. ABOVE LOW WATER

It had a bottom width of 10 ft. and was excavated to 12 ft. below low water unless rock was sooner encountered. The trench rock was placed immediately behind the excavator, which was equipped with a 1-yd. dipper at one end and a boom equipped with a grapple at the other end.

The riprap stone of the trench varied in size from 50 lb. to several tons, only a sufficient amount of small stones being placed to fill the voids and to make a thorough bond with the pavement.

The stone for the subpavement was run-of-the-crusher broken to such size that all would pass a 2-in. mesh and no more than 2% a ½-in. mesh screen. The subpavement was laid to a thickness of six inches.

The paving stone was generally rectangular in shape, having an upper area not less than 1 sq. ft. The first contract provided for a top pavement in one layer 18 in. thick. The contractor furnished stone cut almost to

TABLE I. TABLE OF MATERIAL PLACED AND CONTRACT PRICES, STONE REVETMENT, SAVANNAH RIVER, AUGUSTA, GA.

Trench Excavation Cu.Yd. Estimated Amount	Trench Excavation Cu.Yd. Amount Actually Excavated	Trench Excavation Cu.Yd. Unit Cost (Cts.)	Trench Rock Short Tons Estimated Amount	Trench Rock Short Tons Amount Actually Placed	Trench Rock Short Tons Unit Cost	Subpavement Short Tons Estimated Amount	Subpavement Short Tons Amount Actually Placed	Subpavement Short Tons Unit Cost	Top Pavement Short Tons Estimated Amount	Top Pavement Short Tons Amount Actually Placed	Top Pavement Short Tons Unit Cost	
40,000	30,641	45	54,000	51,417*	$1.65	16,000	15,381	$2.25	48,000	43,952	$2.12	1st Section Hawks Gully to Center Street (1911-1913)
11,000	12,816	60	25,500	25,658	2.00	4,500	4,199	2.50	11,500	12,253	2.60	2nd Section Center Street to East Boundary (1914-1915)
None	None	None	3,500	2,521	3.30	2,000	1,329	3.80	2,300	2,578	4.30	3d Section King Mill Tail-race to 850 ft. below (1917-1918)

* Includes 3,287 tons placed after completion of contract to restore rubble mound to grade. Grading the bank and planting Bermuda sod were included in prices bid for trench excavation and for stone.

TABLE II. UNIT COSTS ON STONE REVETMENT, SAVANNAH RIVER, AUGUSTA, GA.

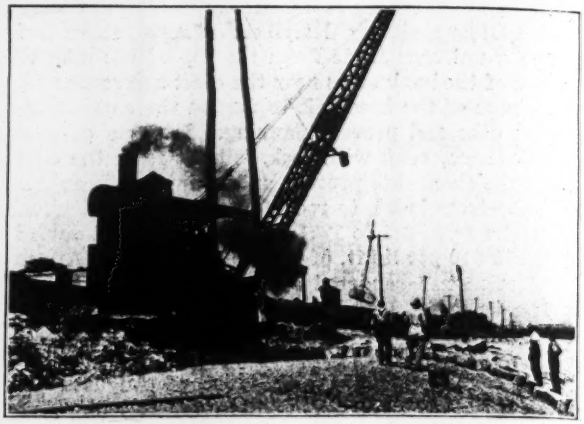
Trench Total Length (Ft.)	Area Paved (Sq.Yd.)	Trench Excavation per Lin.Ft. (Cu.Yd.)	Trench Rock per Lin.Ft. Short Tons	Substone per Sq.Yd. Short Tons	Top Stone per Sq.Yd. Short Tons	Cost of Trench Excavation and Rock per Lin.Ft.	Cost Substone per Sq.Yd.	Cost Top Stone per Sq.Yd.	Total Cost per Lin.Ft. of bank Protected	
7,670	57,200	4.00	6.70	0.269	0.768[2]	$12.86	$0.61	$1.63	$28.59	1st Section Hawks Gully to Center Street
3,250	20,000	3.94	7.89	0.210	0.613[3]	18.16	.53	1.60	28.96	2nd Section Center Street to East Boundary
850	7,000	None	3.00[1]	0.190	0.369[4]	9.85	.72	1.59	28.77	3d Section King Mill Tail-race to 850 ft. below

[1]No trench; rubble mound built up from river bed. [2]18-inch stone used for about 13 per cent. of entire area, 12-inch stone 87 per cent. of area. [3]12-inch stone throughout. [4]6-inch stone throughout.

dimension sizes, and it was laid with only about 5% of voids; thus the revetment became stronger and more massive than necessity required. It was soon discovered that the paving stone as placed was greatly exceeding the estimate, so the thickness was reduced from 18 in. to 12 in., without sacrificing anything in respect to permanence. On the work in the vicinity of the King mill the top pavement was again reduced to 6 in. thickness. Of the entire revetment along the city front about 1000 lin.ft. were paved with 18-in. top stone, about 10,400 lin.ft. with 12-in. stone and 850 lin.ft. with 6-in. stone.

This paving stone ranged in size from 50 pounds to several tons. The small stones were placed by hand and the larger pieces were placed with a locomotive crane operating from trestles (which were susequently removed) or from service tracks built along the top edge of the revetment.

The work so far done is in three major sections, each authorized by a different river and harbor act, and each section covers a separate contract. On the first two sections (from Hawks Gully to East Boundary St.) the City of Augusta paid half the cost and on the third section the Federal Government bore all the expense. The entire work was done under Government supervision.

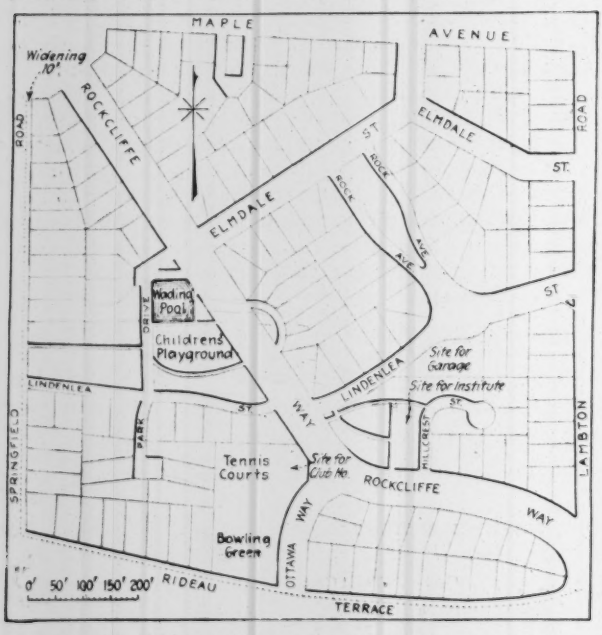


PLACING TOP PAVEMENT WITH LOCOMOTIVE CRANE ON SAVANNAH RIVER REVETMENT

The Lindenlea Garden Suburb and Housing Plan, Ottawa

Land Acquired by Ottawa Housing Commission and Laid Out Under Direction of Dominion Town-Planning Adviser

LAND for a development to be known as the Lindenlea Garden Suburb has been acquired by the Ottawa Housing Commission of Ottawa, Ont., and has been laid out under the direction of Thomas Adams, town-planning adviser to the Canadian Conservation Commission. It is expected that houses will be built at once.



PLAN OF LINDENLEA GARDEN SUBURB, OTTAWA

Most of the houses will be detached and erected on lots having a frontage of 30 to 60 ft. Over 200 applications have been received for house sites, as compared with 168 sites available.

The tract of land acquired has an area of about 22½ acres. Of this over 2½ acres, or fully 10%, has been set aside for parks, playgrounds, and other open spaces, including sites for a community garage and an institute.

The land is somewhat rocky and the topography uneven. The street system and lot subdivisions have been planned to effect economy in street construction as well as with an eye to the best possible appearance. As shown by the accompanying plan, there is a principal street, called Rockcliffe Way, laid out as a diagonal thoroughfare. This is 66 ft. wide along its entire length. Near one end there is a short connecting road called Ottawa Way, from which a good view may be had of the whole of the Dominion Parliament building. The minor streets are of less width, varying with the probable future traffic, and are so laid out that for the most part the lots are regular in shape, although not always rectangular.

In a report on the project Mr. Adams states that the total cost of the land was about $66,000. Incidental expenses of some $15,000 will be incurred. Streets will be macadamized to a width of 14 to 16 ft., and it is expected that this work will be done by the city. The lots are being sold for $340 to $600 each, or 12.8c. per square foot on the average, with a range of from 10 to 15c. Lots fronting on Rideau Terrace, which has already been provided with partial improvements, would be sold at an added price of 75c. a front foot.

Most of the trees will be preserved. An effort is being made to insure the placing of electric and telephone wires at the rear of the dwellings, so that the streets will be kept free from poles. This will mean that the street lighting will have to be arranged by underground wiring, which can be carried out inexpensively as compared with underground wiring for electric services to the dwellings.

A feature of the scheme is a public garage, to prevent the expense of having separate garages attached to each house where a car is kept. There is also a site reserved for a residents' club.

Municipally-Owned Landing Fields

THE status in July, 1919, of the attempt being made by the Director of the Air Service, War Department, to secure the provision of a considerable number of well-distributed municipally owned landing fields, has been summarized for *Engineering News-Record* by First Lieut. Armin F. Herold, by authority of the director, as follows:

Boston, Mass., is setting aside part of Franklin Park, one of the city's playgrounds.

Albany, N. Y., has a good municipally owned field which it is putting into condition to be inspected and accepted by us.

At Binghamton, N. Y., the owners of the Endicott Johnson Shoe Co. are donating a field and preparing the necessary supplies and equipment toward making this field a first-class landing field. It is now ready for use, although it is still in need of some improvement.

Buffalo, N. Y., has accepted our terms in selecting a site.

New York City has referred our letter of Apr. 30 to a committee and proper city departments for action. It is apparently in favor, but not very active.

Rochester, N. Y., is ready to coöperate with the Air Service and is now selecting a field.

Syracuse, N. Y., has a field ready for inspection.

Philadelphia, Penn., is setting aside the tract known as the Belmont Plateau. This is not a strictly first-class location, but it is the best the city has to offer within its corporate limits.

Scranton, Penn., is establishing its own field, for the proposed Lackawanna Air Trail; this, it is understood, is well under way.

Winston-Salem, N. C., has, it is understood, a field ready for use and an officer will be sent to that place in a very short time to make an inspection, it is expected.

Atlanta, Ga., has a field which has been put in good condition, but at present has no hangar or supply facilities. It is ready to establish this field in accordance with our specifications at such time that we may be able to assure the city that it will be used by the Government or the Postoffice Department.

At Macon, Ga., the race-track field will probably be accepted this month and rated as second-class.

Daytona, Fla., offers the use of the beach; it does not care to go to the expense of establishing a field.

Jacksonville, Fla., is very active in the establishment of a municipally owned field, and in a few weeks the field will be ready for acceptance, it is expected.

Kissimmee, Fla., has a field which is ready for inspection and probably satisfactory for acceptance.

Cleveland, Ohio, has a field which, it is understood, is in condition to be used, but no definite steps toward cooperation with the Air Service have been taken.

Springfield, Ill., is very desirous of being added to our list, as it has a good field and is willing to meet all requirements of our specifiations.

Topeka, Kan., is setting a splendid example for the rest of the state by establishing a municipal landing field.

Oklahoma, Okla., has a field which has been used somewhat by our fliers. The post has been operated as a municipal landing field. This field is very unsatisfactory, and probably will not be accepted.

Columbus, N. M., is a village of about 1200, and has neither the means nor the funds to maintain a field in accordance with our specifiations. The village is leasing a field to be used for landings, and will do all that its limited funds will allow.

Phoenix, Ariz., has a field established through public contribution and from money received by means of a carnival, and is ready to expand this field to meet our requirements.

Tucson, Ariz., has a field ready for inspection.

Los Angeles, Calif., is establishing a field.

Cities by which no definite action has been taken or from which no replies have been received in answer to letters sent to them by the Director of the Air Service are are follows:

Uniontown, Penn.; Richmond, Va.; Raleigh, N. C.; Columbia, S. C.; Mobile, Ala.; Baton Rouge and New Orleans, La.; Columbus, Ohio; Chicago, Ill.; Kansas City, Mo.; Beaumont, Flatonia and Texarkana, Tex.; Yuma, Ariz.; Bakersfield and Fresno, Calif.

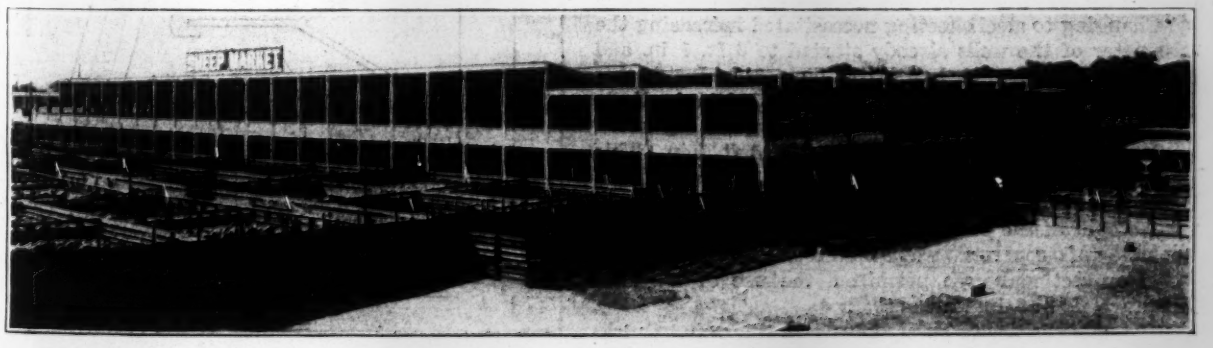
Large Concrete Building at Stockyards

FIRE-RESISTING and sanitary conditions at a large double-deck sheep barn for the Denver Union Stockyard Co. are insured by the use of concrete. The structure is 422 x 320 ft., having stories 12½ ft. high, with no side walls, although a 4-ft. parapet extends around the second floor. The panel spacing is 16 x 16 ft., except for a 20-ft. width at the central driveway. Inserts in the columns provide for the attachment of fences and gates to form pens. Concrete drinking troughs are provided.

Flat-slab construction for the second floor is designed for a load of 150 lb. per square foot. Drainage planes formed in both floors provide for flushing. A sawtooth roof is used, but with a flat slab for the four outer panels, where it is assumed that sufficient light will be afforded by the open sides. Concrete ramps about 15 ft. wide have grades of 16% for the sheep runs and 11% for driveways used in handling supplies.

To resist wear from hoofs a 1-in. granolithic finish is given to the floors and ramps.

While the first cost was approximately double that of a timber structure, the repair cost is reduced to a minimum, and the fire-resisting and sanitary qualities are special advantages. This building was designed and built by the C. S. Lambie Co., Denver, Colo., its details and reinforcement being planned by the Corrugated Bar Co., Chicago.



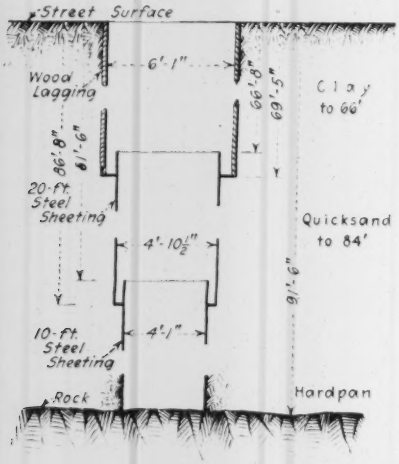
CONCRETE SHEEP BARN AT DENVER STOCK YARDS HAS OPEN SIDES

Foundations in Quicksand and Watery Gravel

Wells Lined With Wood and Steel Sheeting—Heavy Pumping Required—Motor Trucks Handle Excavation and Concrete

SINKING wells for concrete cylinder piers in a city street and through quicksand and water-bearing gravel had to be done in building the foundations for the Canal St. viaduct in Chicago. Four rows of piers built in open wells constitute the foundations for the columns. The contract for the first section of the work called for 120 wells 3 ft. 10 in. in diameter to be sunk to bedrock at an average depth of 90 ft. Three rows are in the existing street and sidewalk and the fourth is in a cleared site along the east side of the street.

Work was begun with open wells or caissons of the usual Chicago type, having a diameter of 3 ft. 10 in. inside the wood lagging, this lagging being in 5-ft. lengths and braced by steel rings. Quicksand was encountered at a depth of 66 ft. and necessitated a change in the method of sinking. Steel sheeting was tried in 30-ft. lengths, but gravel and large stones beneath the quicksand tended to split and deflect the long piles, and



FOUNDATION WELLS SUNK THROUGH QUICKSAND BY STEEL SHEETING

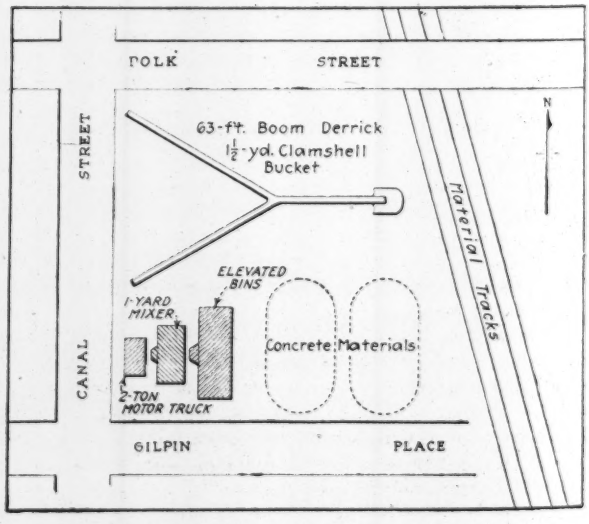
after a few were driven it was necessary to pull them and make another start. A ring of 20-ft. piles was driven readily and was followed by a ring of 10-ft. piles, this last ring reaching the rock. With the increased stiffness and decreased wedging action from external pressures this method proved successful.

Changing to steel sheeting necessitated increasing the diameter of the wells already started to 6 ft. 1 in. and the others were started with this diameter. Inside this was the first ring of steel sheeting, 4 ft. 10½ in. in diameter, and inside of this again was the second ring which extended to rock and had a diameter of 4 ft. 1 in. This construction is shown in the drawing. The height of overlap of the two rings of steel sheeting was necessary on account of the pressure of the quicksand. While the volume of concrete was increased materially, the greater sectional area permitted the use of a leaner mixture, 1:3:6 instead of 1:2:4.

It was necessary to build 30 wells in this way. Quicksand extended from about 66 ft. to 84 ft. below the street level, occurring mainly at the north end of the site. At the south end water-bearing gravel was encountered at a depth of 76 ft., but this did not require steel sheeting. The amount of water to be handled was as high as 500 gal. per minute, and in some cases it was necessary to have five pumps at work on one well. The other 90 wells were in firm clay and were sunk in the usual way, with a diameter of 3 ft. 10 in. inside the wood lagging. In spite of the difficulties encountered every well was sunk and concreted successfully. The equipment included two air compressors of 350-cu.ft. and one of 160-cu.ft. capacity, three 100-hp. boilers, 12 well pumps, and three pneumatic sheet-pile hammers weighing 600 lb. each and two of 1300 lb. each.

As a rule, six wells were in progress simultaneously at the north end and eight at the south end of the work. Each group formed a row parallel with the street, so that at all times there was sufficient clear width of roadway to accommodate regular traffic as well as the motor trucks handling excavated material. The usual tripod frame and hoist was erected over each well, the endless cable operating the group of hoists being led through a conduit under the paving of intersecting streets. At each well there were six men, including a hoist man and a dump man at the top. As it was found economical to have all steel sheeting placed by the same gang, the wells were started in such a way that not all of those in a group would reach quicksand at the same time. This also enabled the pile hammers to be used to better advantage. Wells involving steel sheeting averaged 25 shifts of 8 hours; the others averaged 20 shifts.

Concrete was hauled and placed by two-ton motor trucks having 1-yd. dumping bodies, the entire batch being dumped directly into the well. Both excavated material and concrete were handled in Canal St., the paving of which was left intact except as cut out for the wells. A concrete plant with a 1-yd. mixer was installed between the street and the adjacent railway tracks, a derrick with a 1½-yd. clamshell bucket unloading sand and gravel from cars to stock piles and delivering material to the overhead bins at the mixer as required. During freezing weather live steam was turned into perforated pipes buried in the stock piles. The derrick bucket also handled the cement, transfer-



CONCRETE-MIXING PLANT FOR FOUNDATIONS

ring the sacks from the shed to the charging platform at the mixer.

The contract had the usual clause in regard to such wells, providing that in case water and quicksand made it impossible to use ordinary methods of open-air sinking the work should be done on a cost-plus basis from the time when the more difficult conditions were encountered. It was based on unit prices, differentiating between three mixtures of concrete and between excavation where material was disposed of at the site or removed from the site. This work was started Nov. 15, 1917, but was stopped in May, 1918, on account of war conditions. It has been resumed for the 26 wells remaining under the old contract and 10 additional wells. Of these 20 have the combined steel and wood lining and 16 have wood lagging to rock.

This viaduct will be 1600 ft. long, from Harrison St. to Taylor St., and 800 ft. is under contract. It is part of the improvements in connection with the new union station, and as it will extend over part of the new freight terminal of the Chicago, Burlington & Quincy R.R. the plans are approved jointly by the railway, the city and the Chicago Union Station Co. The Wells Brothers Construction Co. has the contract and P. A. Wells is superintendent in charge of the work.

Fire Hazards Met in Storage of Fuel Oil

Precautions Necessary in the Installation of Fuel-Oil Tanks in Industrial Plants, Observed By Insurance Companies

By J. W. Lord

Engineer, Boston Manufacturers' Mutual Fire Insurance Company, Boston, Mass.

This paper was read at the recent convention of the American Concrete Institute as a part of a symposium on the design, construction and use of concrete tanks for the storage of fuel oil, a type of structure which came into wide use during the war on account of the shortage of hard fuel and of the steel of which to make tanks for the storage of the substitute liquid fuel.—Editor.

PETROLEUM as fuel for mechanical purposes was first used at the refineries of the oil companies, where byproducts were used under boilers and for heating. The first application in furnaces at factories insured by the Associated Factory Mutual Fire Insurance Cos. was about 1888. The introduction, however, was gradual. As early as 1889, following the well known policy of the company of advising its members as to safeguards needed for adequately protecting their interests, preliminary rules for installing fuel oil were drawn up by the Boston Manufacturers' Mutual Fire Insurance Co., and in this, as in all similar work, the idea was not to raise arbitrary objections to processes which were deemed advantageous, simply because involving a hazard, but rather to advise what experience showed to be necessary in order to remove the hazard or take precautions so that it would not endanger the establishment itself or the continuity of its operation.

As an outcome of investigations and experience, it was definitely determined that either a gravity feed for burners, or delivering oil under air pressure, which is in a way equivalent to a gravity system, was not safe and ought not to be used at any plant. Direct pumping to burners is the only safe practice and this has been adopted as a standard. At first, in some cases, the standpipe for maintaining a constant head was adopted, but this practice was discontinued, pressure now being maintained by pumping against a relief valve with an overflow back to the tank. By this means a very uniform pressure is available.

All fuel-oil storage should be underground. The tanks should be located well away from main buildings and not near fire protection mains. Each tank should be independently vented, and the vents should be protected by fire arresters. Steel tanks should hold not more than a carload and should be rustproofed, and, if set in a pit, should be filled around with sand or sound earth free from acid or ashes.

Rules for Construction of Concrete Tanks

Quite recently, concrete has been successfully adopted for fuel-oil tanks of large capacity, and rules for the construction of these have been formulated by the inspection department of the Associated Factory Mutual Fire Insurance Cos. Whether steel or concrete tanks are used, all connections should be taken from the top, as otherwise in the event of settlement the piping will become broken and the entire contents of the tank discharged, incurring not only loss of the oil but possibility of danger. Great difficulty has also been experienced with concrete tanks in making connections oil-tight when under pressure.

The unloading station for tanks at the railway siding should be located well away from buildings, should be level to avoid possibility of a tank-car moving after unloading has commenced, and the ground should be sloped so that oil could not reach buildings in event of accident while unloading. The unloading station should have a metal or concrete pan so that oil will not saturate the ground; this should be large enough to catch the entire contents of the car. The connection for the tank car should be of either pipe with swing joints or metallic hose, thus avoiding rubber hose.

Where storage tanks are installed in batteries there should be valves in connecting pipes between tanks, so that any one tank may be cut out at will. All connections into tanks should extend to the bottom, so that the end of the pipes will be sealed.

There may be cases where it will be found impracticable to bury the storage tanks, and in a large yard, where the ground slopes away from the buildings, they may be sometimes safely arranged by building the tank above ground and surounding it with a levee, enclosing a space sufficiently large to contain one and one-half times the entire contents of the tank, with an allowance for an accumulation of snow and water. The levee should be drained, and discharge pipes should pass over the levee rather than through it. A tank should never be installed under these conditions near enough to buildings to cause damage if on fire.

Whatever the location of the tank, delivery should never be by gravity. In some cases a small service tank, which should be lower than the pump, may be used, and this may be filled from the storage tank by means of an open connection using a funnel. The service tank is not advised, however, unless necessary, as it complicates the system and introduces the spilling of oil at funnel connections.

The pump maintaining pressure to burners should always be located at higher elevation than the tank, and should be so arranged as to prevent siphonic action when the tank is higher than the burners.

All piping should drain back to the storage tank from the burners. The suction pipe should have a foot valve, in order to avoid delay in starting, and also to keep the pipe full, and should be so arranged that the foot valve may be readily removed. Piping should be buried and exposed only where rising from the ground to the burners. It should never be overhead. Valves should all be of the outside screw-and-yoke type, so that their position may be seen at a glance.

Fittings should be extra heavy, and the entire oil system subjected to 150-lb. hydrostatic pressure before being used, as when a burner or pipe becomes clogged there is a tendency to clear by rapping on it, and if the pipe is weak it will be broken and discharge the contents on the floor or into the furnaces.

The supply of oil and air or steam for atomizing should be interlocked in such fashion that if for any reason the air or steam for atomizing should fail the flow of oil would also cease. This can be accomplished, where air is used, by driving a rotary pump by a sprocket chain from the blower supplying the air for atomizing. A reciprocating air pump should have the air supply taken from the same line as the atomizing supply and beyond the point from which the air for atomizing is taken. Where a steam pump is used and air for atomizing, the steam for the pump should be controlled by a valve actuated by the atomizing air pressure. With a reciprocating steam pump and steam used for atomizing, the steam for both purposes should come from the same source.

Pump and Pump House

The pump house should be made noncombustible, with brick or concrete walls and concrete roof. If located inside the main building, the pump should be cut off from the remainder of the room by a substantial masonry wall. If electrically driven, the motor should be cut off from the pump room by a noncombustible partition, and pumps operated by shaft passing through the wall, with switches and fuses located in the motor room.

There should always be a bypass around the fuel oil pump so that all oil may be drained for repairs.

Furnace buildings should, as far as possible, be noncombustible throughout and with all steelwork protected by concrete, and should ordinarily be protected with automatic sprinklers. Where fuel-oil apparatus is located in upper stories of buildings, oil pipe should run up the outside of the building and be protected by incasing in a larger pipe, the furnace being located close to the outside wall so that the run of piping inside may be kept at a minimum. The inside piping should be laid in covered shallow trenches in the floor. Where an oil pipe necessarily runs under a building, it should be incased in a larger pipe made up with tight joints pitched to drain outside the building to small wells, so that leaks may be quickly detected.

Where a tank is filled by tank wagon the inloading station should be at the curb, so that the tank wagon need not enter the yard where fire in the tank wagon might cause large loss to buildings in the vicinity and it would be extremely difficult to extinguish it.

Although a considerable amount of fuel oil now being used is of heavy grade, it should be understood that under certain conditions the oil presents all the hazards of a lighter oil. In order to use the heavier grades at all, it is necessary to heat them, which results in fluidity and introduction of the hazards of the lighter oils. The apparatus as installed will be permanent, and it is entirely possible that with the discovery of new oil fields lighter grades may be used. There have also been cases where unsuitable oil has been received and attempts have been made to remedy the situation by the addition of benzine. The quantity of benzine added would necessarily be indefinite, and the hazard of the oil thus materially increased. It is, therefore, important that with any oil system installed safeguards should be adopted to care for definite hazards.

On the principle that "an ounce of prevention is worth a pound of cure" the efforts of the Boston Manufacturers' Mutual Fire Insurance Co. have been directed largely toward prevention rather than toward method of extinguishing oil fires, although these also have been thoroughly investigated. None of the means of extinguishing ordinary fires is entirely satisfactory when applied to oil fires, and, in fact, there does not at the present time appear to be any certain method. The most satisfactory apparatus, however, is the foam extinguisher, in which two solutions are mixed and pumped onto the surface of the oil, producing a smothering effect and, in cases, complete extinguishment.

Great Care Needed in Cleaning Tanks

An important feature of fuel-oil storage is the necessity of taking precautions to avoid loss of life when cleaning out the tanks. The vapors are extremely poisonous, and as they are heavier than air it is only possible to remove them from the tanks by pumping out. With the presence of sludge, however, which continuously gives off the gas, this method will not suffice. The only safe way then is for workmen to wear either a diver's helmet or a gas mask, and this precaution should always be taken.

Where the steam in a plant is entirely maintained by the use of fuel oil, any material interruption to this service would result in shutting down the steam plant, and consequently the heating facilities would be suspended. In order to be assured of reliability in oil supply, the pump set should be in duplicate.

Summing up the whole question of the use of fuel oil, the general rules which should be followed are few and simple and are briefly stated in the following:

1. Storage tanks should be underground and well away from main buildings and fire mains, and so located that oil cannot flow from them onto the surface of streams in the vicinity.
2. Unloading stations for either tank cars or tank wagons should be safely located and constructed.
3. All piping should be buried and graded to drain back to the tank.
4. Supply to burners should be by pumping, and oil and air or steam for atomizing should be interlocked.
5. The entire system should be mechanically strong to prevent the possibility of breakage.
6. Scrupulous care should be observed in maintaining neat and orderly conditions around the tanks, pumps and oil-burning apparatus.
7. Plans for proposed fuel-oil installations should always be submitted for approval to the underwriters having jurisdiction, before work is commenced.

Largest Use of Electric Power on Construction Work

Dayton Flood Protection Works Use 8000 Hp. From Central Plant, in Motors of 5 to 500 Hp., for Pumps, Excavators, Concrete Mixers and Other Equipment Scattered Over 1000 Square Miles

ELECTRICITY is not particularly a cheaper power, but it is a much more convenient power for widely scattered construction outfits. Fuel is conserved, and the equipment and labor required for serving construction plants are materially reduced. These are the conclusions of the engineers of the Miami Conservancy District, who are purchasing electric current equivalent to about 8000 hp. for the work on the five dams and the two channel-widening operations by which the floods of the Miami Valley will be controlled.

No greater utilization of electric power has been made in engineering construction than in the Miami Valley. No other construction operation has employed electricity as extensively for so many purposes and for actuating motors of such varied size. Current is consumed for some twenty purposes. The motors operated vary from 5 hp. to 500 hp. All types of machines—excavators, pumps, screens, mixers, compressors and shop tools—are motor-operated.

Grasp of the reasons influencing the adoption of electric power requires first a clear understanding of the scope and character of the construction operations. At five points, as numbered on the general map, Fig. 1, flood-retarding basins are being created by building dams. At two more points, numbered 6 and 7, river channels are being widened and deepened and confined by levees. Six of these operations are grouped within a rectangle of approximately 20 x 45 miles, in which is situated Dayton, Ohio, the headquarters of the flood-control operations and the location of a modern electric power plant of large capacity. The seventh operation is at Hamilton, another important center, with local power plants of ample capacity to furnish the amount of power required.

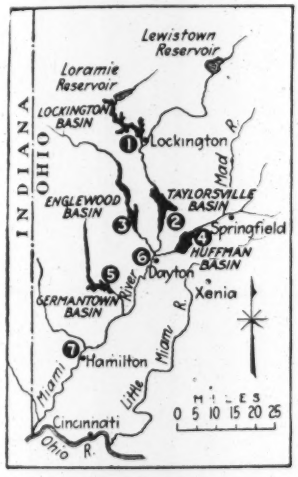


FIG. 1. SEVEN MAJOR CONSTRUCTION OPERATIONS

The five dams are earth embankments pierced by concrete conduits and spillways. Construction of the embankments is largely by hydraulic filling, which calls for large and powerful pumping plants. Excavating machines are required, however, for stripping, for trenching cutoffs, digging cuts for conduits and spillways, taking out borrow pits and for miscellaneous excavation and embankment work. The largest of these excavating units are the 280-hp. dragline machines. For the concrete work there are gravel screening and washing plants, mixing plants and derricks for handling forms and concrete. There are numerous unwatering pumps and well drills, and small equipment for various purposes. The channel operations require mainly outfits of heavy dragline excavators of 250 hp. or more. At each dam a workman's camp requires power for shops and for pumping the water-supply. At one of the camps there are an ice-making plant, a bakery and other equipment for the commissary service. At all camps the cottages, bunkhouses and other service buildings require current for lighting and domestic uses.

About 10,000 hp. is required at all the seven operations, not including haulage by steam locomotives, gasoline motors, motor trucks and tugboats. The division of this total among the several operations varies with their relative progress. At each operation, also, the purposes for which power is required, and to some extent the amount of power, vary with the stage of construction. For example, at each of the dams when concreting is finished, which is comparatively early in the total construction period, much of the concreting plant is dismantled. Meanwhile, as the concreting outfits go out of commission, hydraulic filling begins and increases to a maximum. At all operations the points of power consumption are in part fixed and in part mobile. Excavators, derricks and unwatering pumps are constantly shifting positions, while the water-supply, gravel washing and screening and shop plants remain in one place throughout their service. Finally, since there is interchange of plant units between operations, the same kind of power is essential for all, except perhaps in the case of isolated subsidiary operations.

Why Electric Power Was Adopted

The decision to purchase electric power from commercial central stations was made after thorough consideration of steam and gasoline power generated at individual units. As a matter of fact, a considerable amount of steam-operated equipment is used because it was most suitable for certain isolated points or because war conditions prevented obtaining the electric equipment when needed. The Dayton Power & Light Co. had a plant of 60,000-hp. capacity serving many transmission lines radiating through the territory, and was outfitted and stood ready quickly to build the additional lines required for the flood-control construction operations. Ample current was available to meet the demands of this work.

Electric power presented advantages in adaptability. Current was necessary to light the camps and the construction operations, and was also desirable for many minor power uses. Steam power would have necessitated a generating plant at each camp to supply this current; with electricity the lighting and domestic power problem became simple. Neither steam nor gasoline power presented any superiority in applicability. In fact, in certain applications motors were greatly superior. For operating centrifugal pumps, of which many of numerous sizes are employed, electric motors promised to be decidedly more effective and compact and could be more easily removed in case of floods during construction.

Reliability and economy of power were major con-

siderations. The modern central station, with its several interlocking units, each large enough to generate all the power required, would rarely default in maintenance of supply, it was reasoned. Cutouts in transmission were regarded as a small hazard, and the power company was equipped to restore current with minimum delay. It was believed that induction motors of the sizes wanted for construction equipment would compare in reliability with any steam or gas motor commonly employed. In brief, electric power, it was considered, presented less hazard to continuity of supply than was likely to arise in fuel delivery and boiler and engine breakdowns if steam power were used.

In respect to economy, the comparison was between the high equipment cost, the better utilization of fuel and less attendance required by electric power, and the lower equipment cost, poorer utilization of fuel and greater attendance required by steam power. The mechanical horsepower cost at the machine was not greatly different.

With the factors which have been named balancing somewhat evenly in the aggregate, electric power appeared to be more easy to serve to the machine. For example, a dragline outfit working in the river at Dayton required simply a central transformer station on shore and an individual scow-mounted transformer at each machine. At the dams a central transformer station and several smaller transformer outfits serving individual machines or a group of equipment met the requirements. The superiority of electric-power service appeared evident when contrasted with the transportation of coal to all of these individual machines and groups of equipment over railways and construction roads and across country, its unloading and reloading, and its service from piles and bins. The gain in mobility of equipment also would be material. With motors connected directly to the pump shaft, an unwatering pumping outfit could be mounted and housed on a single frame and hauled by a truck or shifted by a derrick as a unit. In case of the large hydraulic-fill outfits, which must risk overflow at flood seasons, a derrick would lift out the motor when danger came and replace it when the danger had passed, so that pumping might proceed with comparatively little damage to be repaired.

With electric power chosen, distribution and motor equipment were problems to be determined and solved. The central station produces three-phase, 60-cycle, 6600-volt alternating current. This voltage is too low for economical transmission and too high for direct use at the construction operations. Transformers were therefore essential factors of the problem. The determination was to step up the current at the station to 33,000 volts and at each operation again to transform it first to 2300 volts for job distribution and again by local transformers to 440 volts and 220 volts for delivery to the machine motors or for lighting and camp uses.

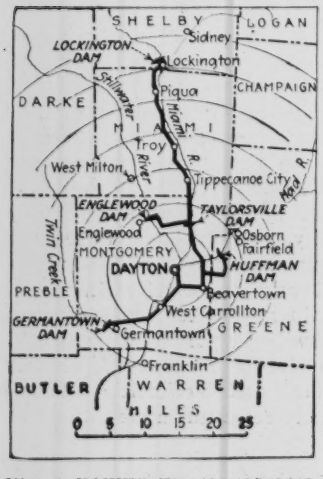


FIG. 2. POWER TRANSMISSION LINES

Transmission lines had in large measure to be constructed to serve the several operations. These lines are indicated by the map (Fig. 2) on which arcs are drawn five miles apart. The longest transmission, to Lockington dam, is nearly 40 miles. The lines are of the usual three-wire type, using wood poles, steel cross-arms and porcelain insulators. The poles average 25 to the mile; every fourth pole is grounded. Bare copper wire (No. 00 on trunk line and No. 2 or No. 4 B. & S. gage on branches) is used. Line construction was completed for the most part early in 1918 and was performed by the forces of the power company.

Distribution of power concerns the constructor most directly. In general features it was similar at all operations, and is best explained by description in detail of the equipment at Englewood, the largest of the five dams, where about 3000 hp. is required. The substation is located on high ground, which is the practice at all operations, for two reasons: (1) To keep the station well above freshets and (2) to isolate it as a safety measure. It comprises a lightning arrester, a switch tower, a 33,000-voltmeter, and six 400-kva. 33,000-2300-volt transformers.

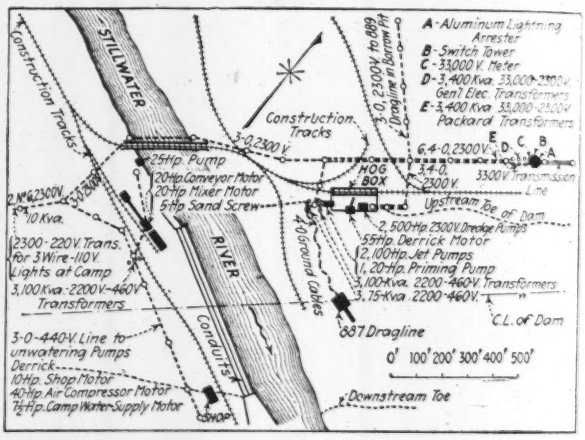


FIG. 3. ELECTRIC POWER DISTRIBUTION SYSTEM, ENGLEWOOD DAM CONSTRUCTION

Distribution from the substation to the various equipment motors is clearly indicated by the plan, Fig. 3. The bulk of the current, and also the heaviest current, go to the 15-in. dredge pumps, each operated by a 500-hp. 2300-volt motor. Ultimately, when two booster pumps are installed for high lifts, 2000 hp. will be consumed for pumping. Except the pumps for hydraulic fill, all machines are operated by 440-volt motors, the 2300-volt current being stepped down by transformers, located as shown by the drawing, except in case of the borrow-pit dragline excavators. For these a portable transformer is shifted with the movements of the machine. Each dragline has a 200-hp. hoist motor, a 75-hp. swinging motor and a 3-hp. air-compressor motor for working the air brakes and friction clutches. All transmission lines are on poles except the take-off cables for the draglines, unwatering pumps, well drills and some other mobile equipment. For these, ground lines of insulated, waterproof, armored cables are used.

Smaller power capacity is required at each of the other operations. Power is purchased at rates based

on the current used and on the maximum demand for current during the month, all current being metered. The meters, located at the main substation, are a graphic-recording maximum-demand meter and a polyphase kilowatt-hour meter. A portion of a record from a maximum-demand meter is illustrated, Fig. 4.

Safety received careful attention. All transformer stations are fenced in and conspicuously marked with danger signs. The voltage of every line is indicated by the color or the shape of the insulator fixtures, so that a lineman knows at a glance the voltage with which he has to deal.

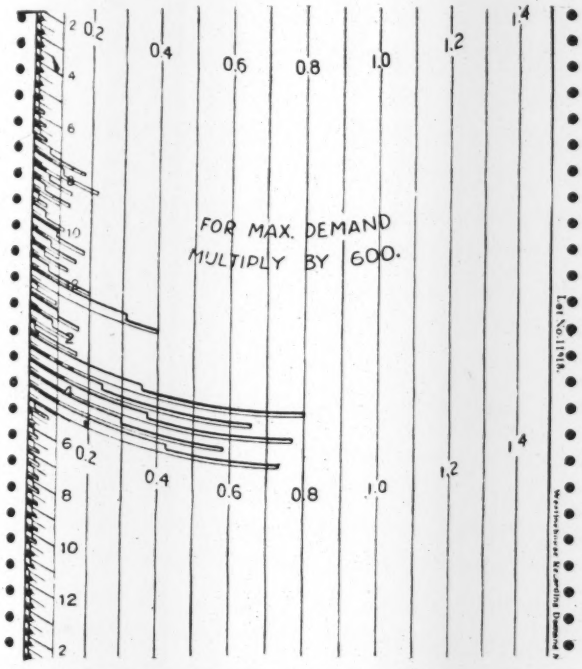


FIG. 4. MAXIMUM POWER DEMAND CHART, TAYLORSVILLE DAM, FOR ONE DAY

The numerals at the left indicate the hour of day; the graph line shows the demand for half-hour periods; the numerals across the chart are multipliers used in computing the maximum demand; 0.8 × 600 = 480 kilowatts, maximum of power used Oct. 26, 1918.

Choice of motor equipment involved a number of problems. The current available pointed to alternating-current motors. Induction motors, moreover, are particularly adapted to construction work. They are mechanically simple and durable; they withstand rough handling and dust and mud, and they require a minimum of attendance, which may be comparatively unskilled. For the majority of uses a constant-speed motor was preferable, and squirrel-cage type induction motors met the conditions. The dredge pumps, dragline excavators, derricks and other similar equipment called for variable speed, and slip-ring motors were chosen.

Since the dredge pumps require the greatest amount of power for the longest time, particular study was given to the choice of the pump motors. Variable speed was essential, and choice lay between direct-current motors and slip-ring alternating-current motors. The former required additional apparatus to convert the current, but were more economical to operate; the latter saved the additional investment but had a higher operating cost. Balancing the two sets of charges, there was left little advantage to either type of motor. Choice, therefore, became a question of relative advantages in operation. The direct-current motor was more complex and required a more skilled attendant, besides involving the operation of the additional apparatus. Consideration of these reasons led to the selection of slip-ring alternating-current motors running at 350 to 500 revolutions per minute.

Besides mechanical efficiency and economy, salvage value and interchangeability were important factors. Sizes and kinds of motor were purchased which would

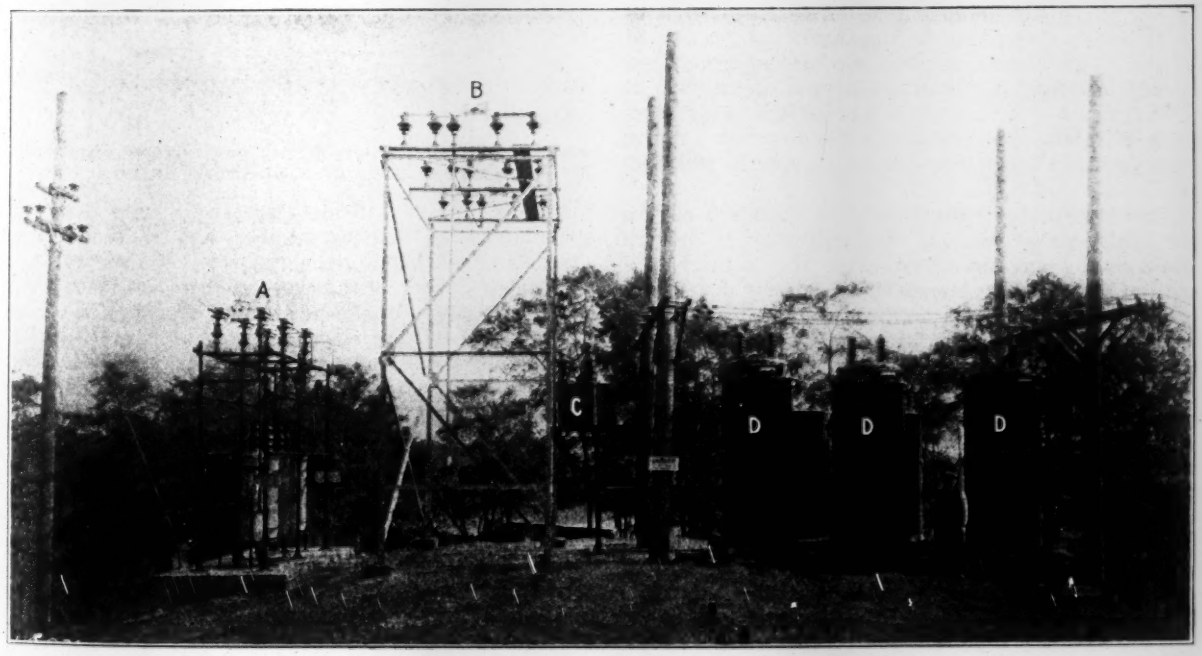


FIG. 5. SUBSTATION UNDER CONSTRUCTION FOR ENGLEWOOD DAM

A, aluminum lightning arrester; B, switch tower; C, 33,000-volt meters; D, two sets of three 33,000- to 2300-volt transformers

bring the largest second-hand prices at the completion of the work. To permit transfer of motor equipment from machine to machine or from one operation to another, and to reduce the variety of spare parts kept for replacement, the same makes and sizes of motors were desirable.

Lower cost per mechanical horsepower at the machine is not the factor that determined the choice of electric power for construction equipment in the Miami Valley. With all costs on both sides fully presented, electric power is not much, if at all, less expensive than steam power might be. The superiority of electricity lies in the facts that it clears the construction operations of the multitudinous tasks of distributing fuel, and reduces the number of workmen to be recruited and directed. It also conserves fuel, an object of consideration when the power was planned, and later, when the war had developed, an object of vital importance. Fuel efficiency at the central station is between 14 and 15%. Transmission and motor losses reduce the efficiency to perhaps 12 per cent at the machine.

The small boiler and engine outfit on construction work rarely gives an efficiency exceeding 4½%. Absence of workmen serving equipment is so noticeable that it invariably excites comment from visitors familiar with construction operations, and this is due in large measure to electric operation. These advantages, rather than the lower cost of mechanical power, are the chief reasons for the employment of electrical construction equipment.

Construction is by force account by the Miami Conservancy District, of which Arthur E. Morgan is chief engineer; Charles H. Paul is assistant chief engineer, and C. H. Locher is construction manager. Frank Harvey is the electrical engineer.

Determining Bearing Value of Alloys

According to the subcommittee on bearing metals of the Research Committee of the American Society of Mechanical Engineers, the only mechanical or physical test of a bearing alloy that can serve a useful purpose is to find whether the alloy has a sufficiently high factor of safety against possible distortion or rupture under specified service conditions at service temperature.

Their studies have convinced the members of the subcommittee that without the application of modern metallography any investigation of this subject is a waste of time. For example, it is entirely due to the dissimilarity of crystals in bronze that it makes a better bearing alloy than brass. The essential characteristic of all bearing alloys is a structure made up of alternately hard and relatively soft microscopic particles intimately mixed. The softer crystals are more readily abraded, and therefore wear slightly below the surface of the bearing crystals, and thus form slight depressions which serve for the retention of the lubricant.

The subcommittee makes the suggestion that a bearing metal may be defined as an alloy that is capable of retaining a lubricant on a bearing surface. It believes that much more can be learned from a study of failures and in studying old bearings, together with their journals, than from accelerated service tests in laboratories.

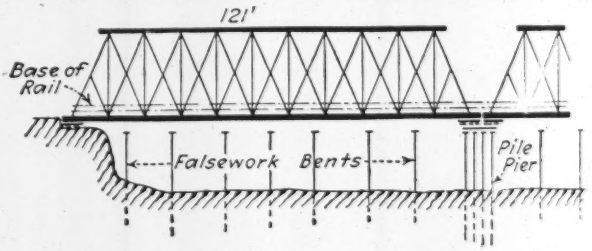
Timber Bridge Problems on the Alaska Railway

Standard Designs for 121-Foot Spans on Sheathed Pile Piers — Car Ferry in Place of Future Steel-Truss Bridge

TIMBER truss spans used extensively on the Alaskan Government Ry. consist mainly of 121-ft. Howe-truss through and deck spans of standard designs, with 56-ft. pony truss spans for small openings. Bridging Alaskan rivers involves careful consideration of flood, drift and heavy ice, especially in streams fed by glaciers, and these factors have to be reckoned with in regard to erection falsework as well as pier construction. As delivery of material is likely to be uncertain at points located far from a base of supply, arrangements have been devised for carrying a temporary deck on the falsework bents in cases where material for the trusses is delayed.

Douglas fir is used exclusively, except that Alaska spruce has been employed to a limited extent for temporary structures and a few small spans. Working stresses are taken at 1200 to 1400 lb. per square inch for bending and 1000 lb. for compression, in case of fire, and 800 lb. for bending in case of the native spruce. No allowance for impact is included in these stresses. Rods and bolts are of wrought iron of 50,000-lb. tensile strength, or of soft bessemer or open-hearth steel conforming to the structural steel specifications of the American Society for Testing Materials. All truss spans are designed for Cooper's E-50 loading.

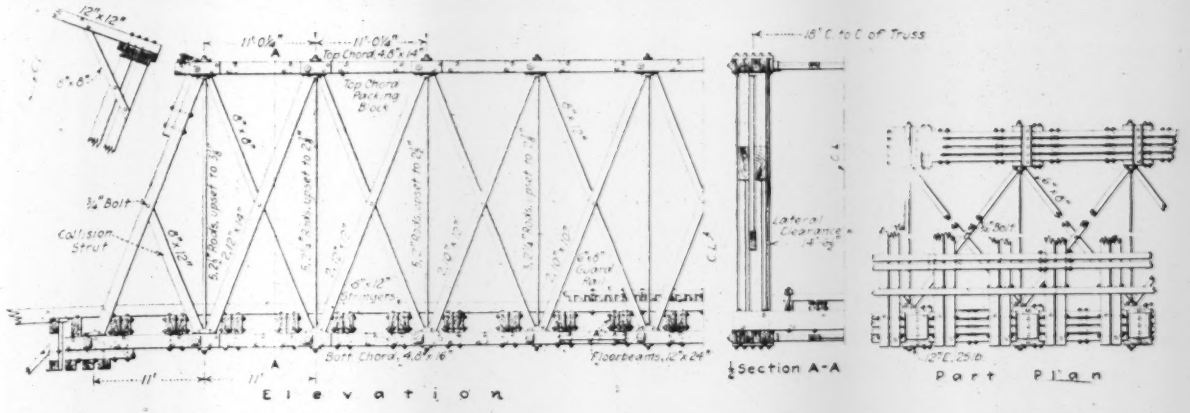
The general design and details of the 121-ft. through truss span are shown in the accompanying drawings. The top and bottom chords are composed of four sticks



TYPICAL 121-FT. TIMBER TRUSS SPAN WITH PILE PIER AND FALSEWORK, KNIK RIVER BRIDGE

8 x 14 in. and 8 x 16 in., respectively, with cast-iron angle blocks for the truss members and transverse steel channels as bearings for the washers of the vertical tension rods. Splices in the chord timbers are made with clamp bars having their ends hooked over lugs on clamp blocks bolted to the timbers. Floor-beams are pairs of 12 x 24-in. sticks, on which are track stringers composed of pairs of 8 x 12-in. sticks and single jack stringers of the same size. A camber of 0.126 ft. is framed into the truss by means of blocking under the panel points of the bottom chords on the falsework during the erection of the bridge, the final adjustment being made by the tension rods.

The piers have four rows of piles with diagonal bracing and have an outside sheathing of horizontal planks to prevent the lodging of ice and drift. In tidal waters, where the current may flow in either direction with changes of the tide, a pile cluster is placed 10 ft. above and below each pier to act as a fender and ice breaker. Falsework bents are arranged as shown in

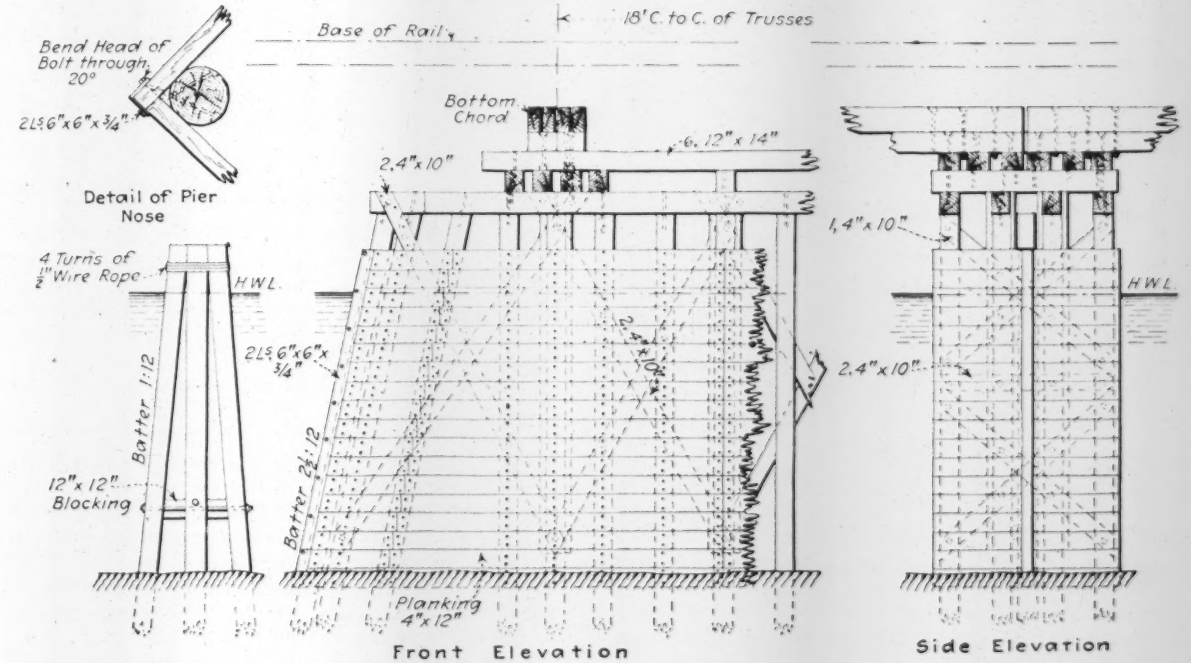


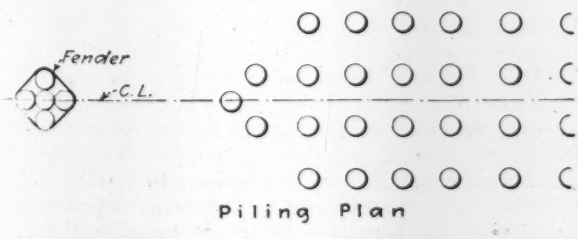
STANDARD DESIGN OF 121-FOOT TIMBER TRUSS THROUGH SPAN, ALASKAN RAILWAY

one of the drawings. Each bent has a 24-ft. cap, 12 x 12-in., driftbolted to four vertical piles which are spaced 14 ft. on centers for the inner and 22 ft for the outer piles.

Carrying the floor or deck temporarily on the falsework bents is a special arrangement made in order to provide for handling traffic when material for the trusses is not at once available. Two lines of stringers composed of two and three sticks with ends overlapping are laid on the falsework caps, with a transverse timber across them at each bent. Upon these timbers is a second and similar course of stringers carrying the track ties. The ties, stringers and cross timbers are secured by loose bolts termed "drop bolts," which resemble drift bolts but are fitted to holes bored to ¼-in. larger diameter. This construction enables the temporary deck to be dismantled readily and without injury to the timbers.

Two of the larger bridges of this type, across the Knik and Matanuska Rivers, have six and five 210-ft. through truss spans, respectively. In these cases special provision had to be made for ice and floods, as both

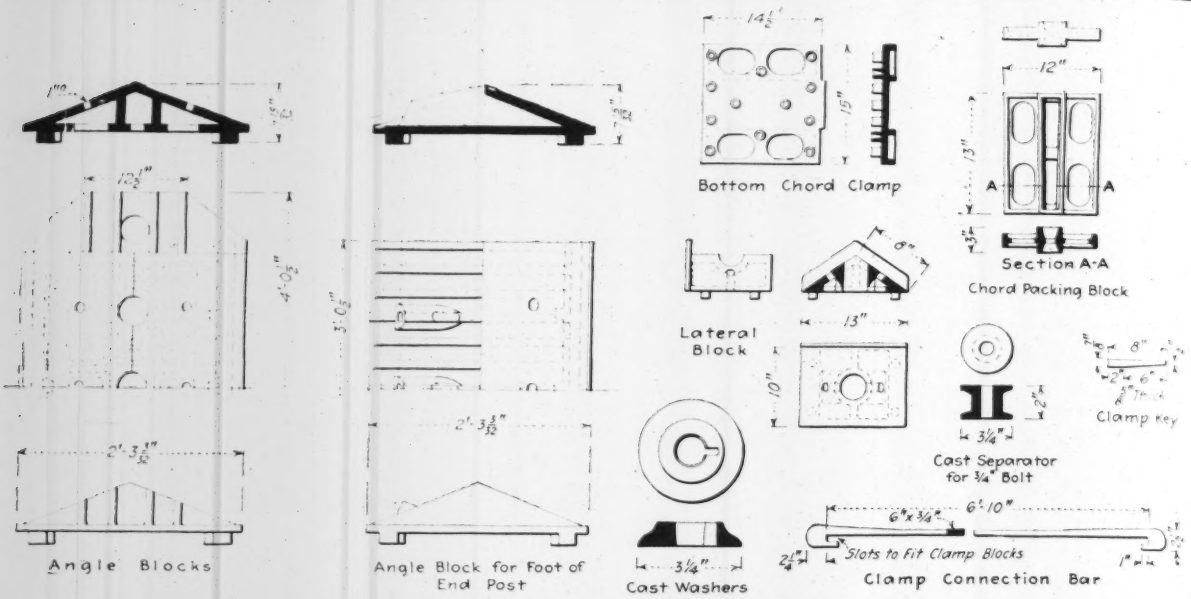




SHEATHED PILE PIER FOR BRIDGES

rivers originate from large glaciers and carry immense quantities of floating ice and drift at certain seasons.

The Matanuska River (or Chatonka, meaning "swift river") carries a large volume of water and quantities of driftwood. The Knik River (or Skidina, meaning "tent-house or summer-house river") comes from a glacier which has an extensive lake behind it. This lake overflows occasionally and breaks through the glacier, causing a destructive flood which covers the entire delta at the mouths of the two rivers. These floods occur generally during September and last from three to four



DETAILS OF THE IRONWORK OF TIMBER TRUSS USED ON THE ALASKAN RAILWAY

weeks. The two bridges are located close to the mouths of the rivers and frequently the current is upstream, owing to the high tides in Knik Arm, which is a branch from Cook Inlet. The extreme difference in level between high and low tides is about 42 ft. at Anchorage and more than this at the bridges, which are about 30 miles further up Knik Arm.

The largest bridge on the railway system will be that over the Tanana River at Nenana, where the width is over 800 ft. and soundings have shown fine sand down to a depth of 90 ft. This is to be a steel bridge on concrete piers with ice breakers, and probably a lift span will be provided on account of the river navigation. As this structure cannot be built for some time, it is proposed to establish a ferry to carry cars during the summer, while in winter a track can be laid on the ice.

All of this railway work has been under the direction of William C. Edes, until recently chairman and chief engineer of the Alaskan Engineering Commission. W. J. H. Fogelstrom is bridge engineer, and the construction is done by railway forces under his supervision.

Calculating Machines in Geological Survey

Extensive use of calculating machines in the work of the United States Geological Survey includes adding machines for totaling long columns of statistics and computing machines for a wide variety of purposes. In working up records of stream discharge, adding machines with a tabulating attachment can, in one operation, tabulate the daily discharge and determine the monthly average. In the physical and chemical laboratory of the survey the machines are found particularly useful in the computation of mathematical tables, the reduction of data of observations and the evaluation of physical constants by the method of least squares. For such work the machines are considered preferable to logarithmic tables when five or more decimals are required, as their use is found to impose less strain upon the eyes, while the mental effort required to operate the machine is generally less than that of making interpolations from a table.

Proposed Types of Vehicular Tunnel Under the Hudson River

Brief History of New York-New Jersey Tunnel Project—Traffic Estimates—Details of the Plans Being Considered

VARIOUS possible types and details of tunnel sections for the New York-New Jersey tunnel under the Hudson River are now under consideration, and a contract for further rock boring has recently been let. The following short historical sketch, together with details of various proposals, is taken from the report of an informal discussion at a meeting of the American Society of Civil Engineers, published in the *Proceedings* for May, 1919, p. 249. As the War Department restrictions require only a clear channel of 1000 ft., with 40 ft. depth, either the trench method or a subaqueous tunnel can be used.

According to the short historical account given by Edward A. Byrne, chief engineer, Department of Plant and Structures, New York City, although the construction of a bridge across the Hudson River had been agitated for many years it was not until 1906 that official action was taken by the States of New York and New Jersey. In that year both states appointed bridge commissions to report on the advisability of building a bridge. In 1913 additional powers were granted to the New York commission by the legislature, enabling it to direct its attention to tunnel construction; the New Jersey commission received like powers from the legislature of that state.

In February, 1913, Jacobs & Davies, consulting engineers, reported to the commission that a tunnel was entirely feasible. In January, 1917, a board of engineers consisting of W. H. Burr, Ralph Modjeski and G. B. Moran reported to the Public Service Corporation of New Jersey in favor of the construction of a tunnel by the trench method. In September, 1917, Gen. George W. Goethals was retained by the Joint Commission to report on the best type of tunnel to be built, and in November of that year he recommended the construc-

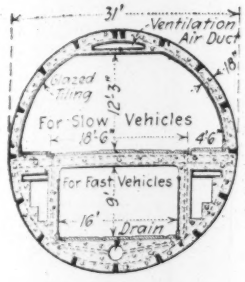


FIG. 1 - Jacobs and Davies 1910

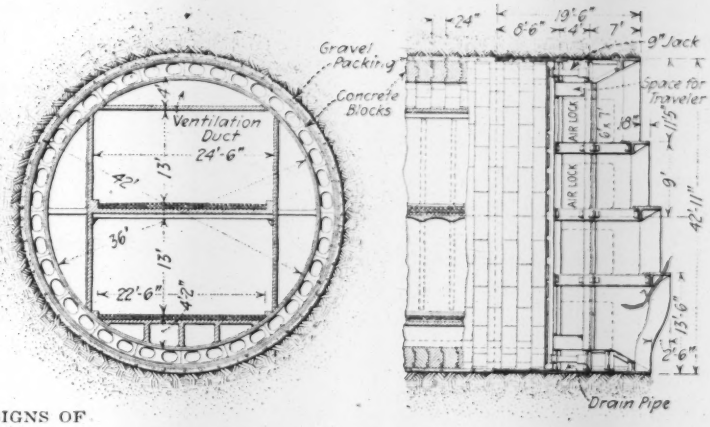


FIG. 2 - O'Rourke's Modified Design, 1919

Details of Concrete Block

FIGS. 1 AND 2. TWO DESIGNS OF SHIELD-DRIVEN TUNNEL

At left is a design of Jacobs & Davies for a medium-size tube, superseding the firm's original design for small tubes; at right is O'Rourke's revision of his previously published plans for a large tunnel and a shield to drive it.

tion of a single tunnel with two levels, using the shield method and precast concrete blocks.

Two tubes to be built by the shield method were recommended in the report by Jacobs & Davies, each having a roadway width of 17 ft. and a headroom of 12½ ft., the inner diameter to be 22 ft. and the outer diameter 25 ft. in each case, with the New Jersey terminal at Twelfth Street, Jersey City, and the new York terminal on Canal Street. For lining, cast iron was recommended, with a concrete facing. In 1910 the same firm prepared a plan for a two-level tunnel, a cross-section of which is indicated in Fig. 1 herewith.

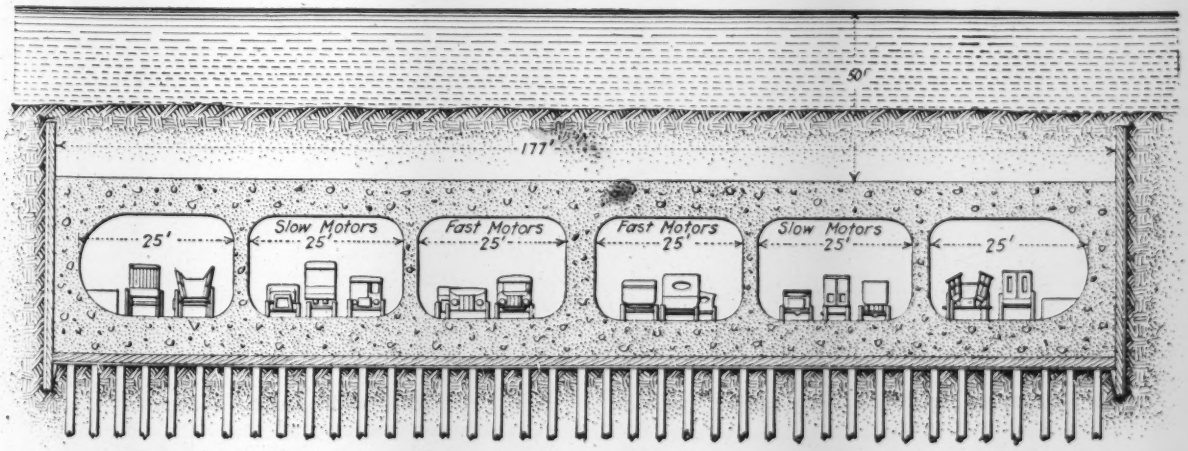
Mr. Byrne pointed out that ample headroom is afforded for each type of traffic. For example, the highest slow-moving truck is about 10 ft. 3 in high, for which a headroom of 12 ft. 3 in. is provided; the highest limousine automobile is 7 ft. 10 in., with headroom of 9 ft. The estimated cost at pre-war prices was $11,000,000. The total traffic capacity was given as 5,000,000 per year.

The Burr, Modjeski and Moran report, in favor of the trench method, recommended that the section in the river be of reinforced concrete resting upon timber piles. It was to be generally elliptical in section, the inner major axis 28 ft. 4 in., the outer axis 36 ft. 5 in.; the over-all distance from top of piles to roof 28 ft. 10 in. One roadway 17 ft. wide with headroom of 13 ft. and two foot-walks, one 5½ ft. and one 3½ ft. wide, were to be provided. The estimated cost was $6,899,000, and the traffic capacity 15,417,600 vehicles per year.

As stated by Mr. Byrne, the reconstruction commission of New York has invited criticism of the Goethals plan, the points raised being: (1) Is the type of tunnel proposed possible of construction? (2) After it is constructed, is it usable? (3) Are the estimates of cost anywhere near correct?

The unusual size of the single tunnel, 42 ft. outside diameter, as illustrated in Fig. 2 herewith, requires a special type of shield which has been designed by J. F. O'Rourke, consulting engineer and president, O'Rourke Engineering & Construction Co., New York City. This shield is divided horizontally into four sections, and has multiple air chambers in its forward part, as illustrated in the longitudinal section of Fig. 2. Details of the precast concrete blocks are also shown. General Goethals has approved this shield and states that it will do the work of excavating the tunnel.

The roof of this tunnel will be 50 ft. below mean low water, and the tunnel 9300 ft. long. General Goethals' estimate of cost is $12,000,000, and at a hearing before



PROPOSED SECTIONS FOR NEW YORK-NEW JERSEY VEHICULAR TUNNEL UNDER HUDSON RIVER

the reconstruction commission Mr. O'Rourke submitted a proposal to build the tunnel complete for $11,500,000 at the present war prices. The traffic estimate for this tunnel is 36,500,000 vehicles per year. A detailed description of the proposed shield, patented by Mr. O'Rourke, was published by him in *Engineering News-Record* of Mar. 21, 1918, p. 563.

In Fig. 3 is shown the proposed reinforced-concrete tunnel section recommended by T. K. Thomson and Francis L. Stuart, consulting engineers, New York City. In the discussion Mr. Thomson said that although the ventilation could be taken care of, yet separate compartments should be provided for foot passengers and horse-drawn vehicles, and for the fast and slow motor traffic. Asserting that the tunnel would rise and fall with the tide, and that the tunnel lining with the proposed concrete blocks would not be as strong as that of the Pennsylvania tunnels, for example, he said that it would be better to construct a tunnel which would always be rigid and in a state of equilibrium, and that this could be done by the open-trench method.

Trench Method Applied on Large Scale

By the dredging of a channel and the driving of an ample number of foundation piles to receive them the tunnel sections could be built on the surface like a boat, with bottoms, sides and roof of reinforced concrete say 6 ft. thick. The length of the sections could be 1000 ft. or more, and an air chamber could be provided below in order to permit any additional excavation, if desired, after the section had been sunk. He asserted that the tunnel could be placed at a higher level than a shield-driven tunnel, thus shortening the approaches by a thousand feet or more, and that, without costing any more to construct, it would have three times the capacity of the shield-driven tunnel.

Amos Schaeffer, consulting engineer, Borough of Manhattan, New York City, after saying that two smaller tunnels could without doubt be shown to cost less than the larger one, went into details regarding the capacity or traffic requirements. Reviewing the assumptions upon which the capacity of 100,000 vehicles per day claimed for the one large tunnel was obtained, he concluded that the capacity of the proposed tunnel is greater than necessary for the present needs of traffic and of the immediate future, since the assumptions were based upon a 24-hour day, whereas a 12-hour day is the longest that could be used as the time basis. Claiming a margin of safety of not less than 100% for reduced spacings between vehicles of 30, 40 and 60 ft. for speeds of 3, 9 and 15 miles per hour respectively, he finds a capacity of 74,000 in both directions, based upon a 12-hour day and six lines of traffic. If traffic should increase 8% per annum over the 8000 vehicles per day assumed for 1922 at the completion of the tunnel, there would be 37,160 vehicles per day in 1942; or, 20 years after its completion only about one-half its capacity would be required.

Motor-Express Route Tariff Sheet Adopted

A motor-express route tariff sheet has been promulgated by the Highway Transport Committee of Douglas County, Nebraska, and has been adopted by the State Public Utilities Commission. It is believed that this committee is the first organization in the country to compile and have adopted such a tariff sheet.

Rough Field Tests for Concrete Sands

IN REMOTE places it is sometimes difficult to make proper quantitative tests of the various sands available for concrete work. In some operations for the Hawaii Loan Fund Commission, A. O. Rose, who was then assistant engineer of the commission, developed a bending test which he considers gave him values of importance in the particular case.

The isolated location of various structures, the high transportation costs, and the questionable quality of certain local sands, made it necessary to determine the relative suitability of the materials available for certain contemplated structures. These materials were a fine, black beach sand with rounded grains, a gray, volcanic sand, San Diego sand used as ballast by vessels from California, and fine grit from the crushing of blue lava rock.

Test bars 1 in. square in section and 12 in. long were cast of 1 : 3 mortar mixture, using a standard brand of portland cement and the various sands mentioned. At the end of a seven-day period the bars were tested to destruction as beams with a 10-in. span and a concentrated load applied midway between the supports. Knife-edge supports were approximated by the use of triangular sections of hard wood, and concentration of load at the center of the span was obtained by applying weight to a round iron ¼-in. rod placed across the top of the beam at the center point. Load was applied by slowly pouring sand into a bucket supported beneath the beam by hooks attached to the iron rod. The weight causing failure was determined, and the tensile strength of the mortar was then obtained by computing the extreme fiber stress at the lower edge of the test bar.

The general results obtained from these tests are:

Material	Mixture	Tensile Strength, Lb. per Sq. In. Low	High	Average
Portland cement	Neat	545	747	660
Black beach sand	1:3	54	134	96
Volcanic sand	1:3	130	242	177
San Diego sand	1:3	144	314	232
50% crusher grit 50% volcanic sand	1:3	149	228	208

Although the beach sand noted above was in general use for concrete work, its use on the work was prohibited on account of the heavy loadings involved. Volcanic sand and crusher grits were used for the greater portion of the work, the San Diego sand being relatively expensive and the crusher grits alone requiring admixture of other fine aggregate at times, to secure proper consistency of the concrete.

Cheyenne Corner Gutters Depressed

Depressed gutters around corners from cross-walk to cross-walk are installed in many of the main streets of Cheyenne, Wyo., to carry the storm water, as storm drains have only recently been authorized by a $300,000 bond issue voted upon favorably July 27. Water is carried across streets under the crossing, a flat arch of corrugated iron covered with concrete forming the wide and low conduit. The corner gutters are about 2 ft. wide and 4 to 6 in. deep, the outer curb being level with the road. Most of the construction was put in before the advent of the automobile, for the gutter forms a serious hazard to the reckless driver who cuts corners. The 80-ft. width helps. No streets are paved, for the natural disintegrated granite when shaped and then watered makes an ideal surface during all kinds of weather.

Principles Underlying Determination of "Fair Value"

Report of the Committee on Valuation of the American Electric Railway Association Defines Bases for Appraising Public-Utility Properties for Rate Making

The following is the report, in full, of the Committee on Valuation of the American Electric Railway Association, which will be presented at the convention of the association this fall, in Atlantic City. The report has been made public by the Executive Committee of the association. The Committee on Valuation consists of Philip J. Kealy, chairman, George Weston, W. J. Harvie, B. E. Tilton, J. N. Shannahan, W. H. Sawyer, Charles E. Bailey and Martin Schreiber.—EDITOR.

THIS report is predicated upon the assumption that public utilities in the future will be regulated by national, state and municipal authorities to the extent necessary to insure good service to the public and to provide a sufficient income to cover the costs of the service, including fair wages to labor and a fair return upon the investment. The rate of investment return should be such as will attract investors and the security of the investment should be placed beyond question so that the companies may obtain, at minimum rates, the capital required for the extensions, betterments and improvements necessary to keep pace with population growth and future transportation requirements. It is further anticipated that public service commissions and other interested governing bodies will recognize the opportunity that the present emergency affords them to perform a good and useful public duty by safeguarding the integrity of utility investments and by establishing methods that will insure good service to the public. They should be as liberal in their dealings with the companies as the urgency and gravity of the present general situation demand, and a proper consideration of the public interest and general economic stability will permit. On the other hand the companies should only ask for such treatment as a fair analysis of the conditions warrants, and that they can with propriety and reasonable assurance defend.

How Shall "Fair Value" Be Determined?

Two very important items involved in determining the proper rates of fare that any company may charge to produce an adequate gross income are the "fair value" and "rate of return" to be allowed upon such value.

In view of the great importance of the item of "fair value," in rate making negotiations, the association requested the valuation committee to prepare, at the earliest possible date, a report setting forth its recommendations as to the proper procedure to follow in determining "fair value." It was the hope that through the work of this committee, representing practically all of the street railway companies in the United States, there could be evolved a method of valuation based upon safe economic principles, and acceptable to investors, public utility commissions and other public rate making bodies. In attacking this problem your committee realizes the many conflicting opinions that have prevailed and the many mistakes that have been incorporated in public utility valuations in the past. However, it is the unanimous opinion of the committee that it is the earnest desire of all interested parties, the courts, public utility commissions, municipalities and other governing bodies, as well as the companies, to evolve a method of arriving at the fair amount of capital upon which to base a return and that this can be accomplished by the application to the problem of common sense business methods.

There can be no question but that the investor in any public utility serving the public is entitled to a fair return upon his investment until it has been returned to him. Accepting this principle as an "axiom" every dollar spent in creating the property including the individual efforts (the equivalent of money) of the promoters, organizers and builders of the property, and including the superseded property unamortized out of the earnings of the road, should be included in the "fair value," also, an investor in a company is entitled to a reasonable return upon his actual original investment, plus the appreciation of the property, including its value as a "going concern," as compensation for his "initial risk" or "hazard" and his skill in successfully operating the property. In other words, an increase in capital value is the same as an increase of new capital.

General Principles of Valuation Stated

With these general premises in mind the committee makes the following statement of general principles involved:

1. Where "original investment" is used as a basis of "fair value" and complete "original cost" data, covering all expenditures including promotion, organization, cost of financing, contingencies, etc., are available, there should be added to these original cost figures any appreciation, including a fair value for going concern, and there should be no deduction for unamortized superseded property or for accrued physical depreciation in a well maintained property.

2. Where full and complete original cost data are not available, the "cost to reproduce new" method should be used. An inventory of the existing property should be made using prices as of the date of the inventory. This date should coincide with the time the valuation is being made, the prices being expressed herein as "prices of today." To this "bare bones" inventory and unit price summation should be added the proper "overhead" percentages, "going value" and other development costs to complete a full "fair value" for "rate making purpose," and there should be no deduction for accrued physical depreciation in a well maintained property.

It is seldom that the older properties have a complete, reliable record of total actual expenditures and therefore it has become the almost universal practice to inventory the existing property and apply unit prices to the different items of construction.

In some cases, valuations have been made upon several different bases: (1) Original cost data. (2) Reproduction cost with prices as of dates of construction. (3) Reproduction cost with price as of today. (4) Reproduction cost with prices averaged over several years.

In all cases the proper overhead charges and development costs should be added to determine a fair value for rate making purposes.

Items to be considered in estimating fair value for "rate making."

(a) Promotion expense	
(b) Organization expense	
(c) Brokerage	
(d) Construction costs	(Based upon actual property inventory at prices as of the day and date of inventory.)
(e) Overhead direct charges not included in (d)	Engineering and superintendence. Storeroom expenses, cost of handling materials, clerks, general office help, contingencies. Contractors' profit. Carrying charges during construction. Taxes during construction. Insurance during construction.
(f) Going concern	(1) Cost of consolidation (2) Superseded property (3) Created value (4) Development costs
(g) Working capital	

Definition of Terms

Promotion Expense—The initial work necessary to start a public utility enterprise requires the time, effort and work of capable men to plan the proposed service, to show its public necessity, to estimate the possible business and prepare construction costs, gross receipts and operation expense statements, and the preliminary work necessary to procure franchises, etc. This work is a service of value to the public and represents a money value properly chargeable to capital account.

Organization Expense—An efficient organization must be carried during the formation and construction period consisting of legal, financial and business experience and ability to arrange for and carry on the details of company organization and the creation and construction of the property. This expenditure is a proper charge to capital account.

Brokerage—The money necessary to create the properties must be arranged for through sales of stock and bonds, and bankers or brokers are generally engaged to place the securities and collect the money as required. This means: The payment of commissions, preparation of mortgage, service of registrar (corporate and individual), service of trustees, cost of certification, revenue stamps, cost of recording mortgage, public service commission costs for approval, advertising, and other expenses, and this brokerage cost should be included in any investment estimate for rate making.

Construction Costs—A detailed inventory and classification of the existing physical property forms the basis of all "cost-to-reproduce-new" valuations, to which should be applied unit prices and costs or value as of the date of inventory. The value based upon present day prices is then in accord with the current rates of wages, the current cost of material and the current value of a dollar and is economically sound. To the "bare bones" inventory at unit prices must be added the direct and indirect overhead charges not included in the unit prices for rails, other construction materials, labor costs, etc., all as enumerated.

Overhead Charges—The items of direct overhead charges enumerated above should require no further explanation. The purchasing of the materials, their transportation, sub-delivery, accounting, inspection, etc., require supervision and direction and the effort of large forces of storeroom and general office help, inspectors and checkers, the cost of which is not included in unit prices.

The general and detail design of all parts of the property requires the work of engineers and architects and their assistants to prepare drawings, bills of material, working specifications and purchase contracts, take the general direction of the work in the field, make estimates of cost, progress estimates and partial payment estimates for all contracts and generally supervise the progress of all parts of the construction, the cost of which could not be included in unit prices.

During the progress of the work, cash must be provided to pay the current labor, material costs and partial payment contract estimates, and interest must be paid upon this capital as it is invested during the period of construction and before the property can earn a return. The same is true of taxes, and insurance, both fire and accident. Interest, taxes and insurance during the construction period are a part of construction costs and should be a capital charge.

In the building and erection of a large property many contracts are entered into for specific kinds of materials in quantities, special machinery, track work, buildings, etc., and the item of contractors' profit is one of the construction costs that must be included in "fair value" for rate making.

Contingencies an Important Item

The item of contingencies is an important one in any cost estimate whether it is to furnish advance information to financiers and promoters, or in connection with any large public improvement, or our own problem, "the establishment of a reasonable and just investment value." This item covers the uncertainties, commissions, additions and extras attendant upon any construction job, large or small, and among many other things, includes the following unforeseen but ever-present items of delay: Removal of obstructions, the appearance of conglomerate, hardpan, or solid rock in excavations where earth had been estimated, slides in open cuts, the removal and restoration of water pipes, gas pipes, electric wires and other underground improvements, underpinning of buildings, etc. The item of the removal of underground obstruction alone often equals 25 per cent of the total construction costs in subway work. To quote from the paper on "Overhead Charges" presented by Philip J. Kealy in the 1916 report of this committee, the following statement appears under the heading "Incidentals or Contingencies."

> During a recent hearing before the Valuation Committee of the Interstate Commerce Commission, Mr. Holbrook chief engineer of the Union Pacific Railroad, stated that after the completion of the Lucin cutoff across Great Salt Lake, he had his engineering staff estimate the cost of the work already completed and the highest estimate was 40 per cent. under the actual cost.

This item of contingencies is a real item of cost in every job and ranges from 10 to 50 per cent of the total cost and in some hazardous undertakings such as under-water tunnel or foundation work the actual cost is sometimes many times greater that the "bare bones" bill of material contract-specifications estimate of costs.

Going Concern—(Health of the Property). This represents the value that exists in a completed, matured, successfully operated property and embraces the items of "readiness to serve," a "built up successful business," etc., as compared with a new property in the course of

construction, or the immature condition usually prevalent at the beginning of its operation. Other development costs, including an amount equal to the deficiency of net earnings below a fair return upon the fair investment due solely to the time and expenditure reasonably necessary and proper to the development of the business and property to its present stage and not comprised in the valuation of the physical property are also involved in this cost.

Cost of Consolidation—In the past competing companies were granted franchises in the same community and duplication of operating organizations and other expenses resulted together in less efficient and more expensive service to the public. Under one management the public has benefited by a lower average fare, the more direct routing of cars and an extension of service for a single fare. Much time, effort and expense are usually involved in bringing about a consolidation. This development expense is of value to the public, and its cost is a proper charge to capital account.

Superseded Property—A public utility company is entitled to repayment for all of its property consumed in the service of the public. The ordinary replacement or renewal of property actually worn out in the service is charged to operating expense and is therefore amortized out of earnings. It is only when large replacements of property are made necessary by extraordinary changes of motive power such as from horse car to cable or electricity or both, or by wreckage due to violent storms, earthquakes or other unusually destructive calamities, or when because of improvements in the art, the general type of car or other property in service is replaced in large quantities that it becomes impracticable to amortize immediately out of earnings and new capital must be used. This new capital should be included in "fair value" upon which to base a return until such time as it has been amortized.

Created Value—This item covers an important element of value that properly may be a part of "going concern value." It represents the value due to the utility having been brought into existence and becoming alive and a vital part of the community. Having pioneered the growth of the city or community and enhanced the value of both private and public property, the utility itself should be justly credited with part at least of the value it so created.

Working Capital—Every business should have a "cash reserve" or "working capital" to "cushion" the rise and fall between income and expenditure, to carry the materials and supplies account, and especially to fortify it against any reasonable financial emergency that may arise. An adequate allowance for this item should be included in capitalization.

Bond Discount—This item has been set up as one of the problems to be considered in "rate making." A new public utility seldom sells its securities at par, but bond interest is paid upon par value and must be included in the rate of return. The question of "bond discount" has been considered in many public service rate cases and has been allowed as capital in some instances. In the majority of cases, however, it has been considered as representing prepaid interest and therefore a matter to be included in rate of return rather than to be capitalized.

The prevailing practice in making valuations for rate making adopted by public service commissions and other public utility supervising bodies in the past has been the "cost-to-reproduce-new-less-depreciation" method. There has been little argument between the companies and those representing the public about correctness of inventories. More differences of opinion have arisen with respect to unit prices, overhead and "going value" percentages, and the method of determining the amount of depreciation to be deducted

Depreciation has been classed by all students of the subject as an operating charge and not a capital account item. The only provision that can be made to take care of depreciation is by making proper repairs and proper renewals when necessary and these expenditures should be charged as an operating expense, that is, in the case of renewals the original cost of the thing replaced should be charged to renewals and any excess or betterment is a proper charge against capital. The integrity of the capital investment is thereby maintained against depreciation to the extent practicable or economically possible. An exact standard of percentage physically good to apply to any well maintained electric railway property is difficult to establish because this percentage will vary in different properties and is influenced by different types of property and equipment, the physical characteristics of soil and other local conditions, and usage. A property consisting of a large percentage of elevated or subway construction will show a much higher percentage of the total investment physically good than a surface electric railway property. Every public utility property should be maintained at 100% operating condition, but it is both impractical and uneconomical to maintain any property approximately 100% physically good. This is true for the reason that the physical per cent good of any property will vary from approximately 100% in the case of a new property, to 80% or less, in an older property, depending upon the age, the different stages of renewal cycles through which the property has passed, and the amount of additions and betterments.

Accrued Depreciation and Deferred Maintenance

There is a certain amount of total accrued depreciation that never can be taken care of in any operating, growing property. In other words, as stated above, the only practicable, economical expenditure that can be made to offset depreciation is to make repairs, and renewals when physically necessary. There is no fairness or logic in an attempt to penalize a company because it has not done the impossible. The full original investment remains in the property and the investor is entitled to a return upon every dollar until the investment is repaid to him. Where a property has not been kept in good physical condition and there is unmistakable evidence of "deferred maintenance" the subject should receive special consideration and if the property being valued has been a prosperous one in the past and the fact is in evidence that the money that should have been expended for renewals and repairs has been diverted to other uses of benefit to the company, the company should be required to make good this deferred maintenance, the cost to be charged to its individual account and not to operating expense.

If, on the other hand, it can be shown that a company carrying deferred maintenance has been well managed but that the income has not been sufficient to pay the increased costs of operation, franchise obligations and

interest and, in addition, properly maintain the property, then provision should be made in the rate adjustment to permit the company to earn the amount necessary to put the property in good operating condition.

Your committee wishes to emphasize its conclusions with respect to the subject of accrued depreciation in the strongest manner possible, as follows:

Where a property has been maintained in good operating condition and an appraisal is being made to determine investment value for "rate making" or for sale to municipality, state or government, no deduction should be made for accrued depreciation.

Mechanical Method for Determining Reactions in Continuous Girders

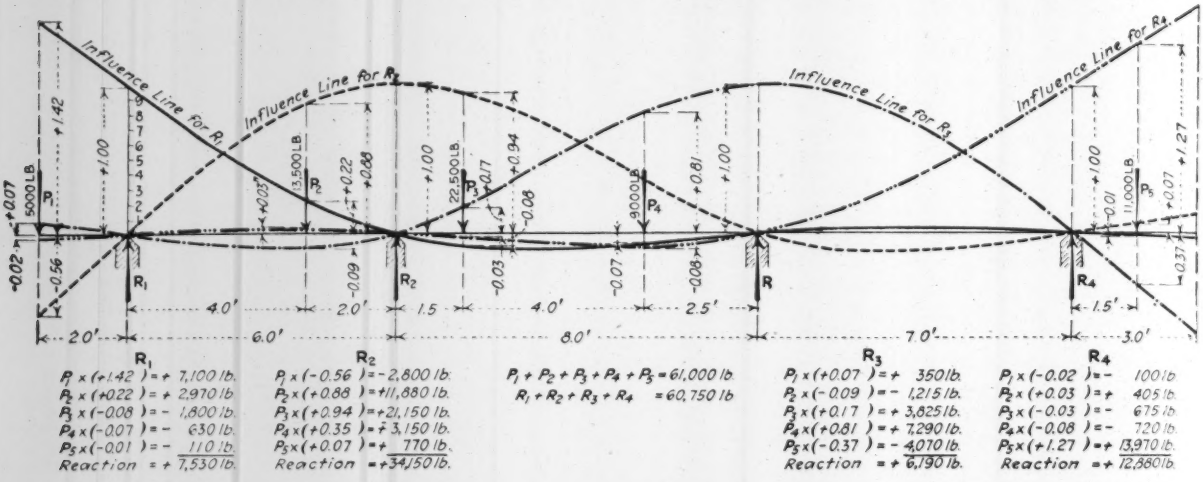
BY R. FLEMING
American Bridge Company, New York City

THE average engineer is called upon only at irregular and widely separated intervals to deal with some phase of the continuous girder. This necessitates his turning to a textbook and reviewing the subject, but the knowledge gained is forgotten by the time the subject comes up again. Prof. George E. Beggs of Princeton University has devised a simple mechanical method for determining the reactions at the supports of continuous girders due to concentrated or uniform loading. Within an hour after the professor explained the method to him, the writer had purchased a 3-ft. spline such as are used in drawing curves and was finding the reactions in the example herewith. The method may be described as follows:

It is assumed that the supports are on the same level and that the moment of inertia is constant. Lay out the supports and the loads in their correct relative position, and at each support lay off, perpendicular to the line joining the supports, an ordinate equal to unity, according to any convenient scale. Place the spline so that the upper edge coincides with the level of supports. Choose the support for which the reaction is first desired, and insert a pin at each of the other supports. At the chosen support press the spline upward until it reaches the top of the line unity.

The spline will take a curve, easily drawn by passing a pencil along the upper edge. This curve is the influence line for the reaction sought. At each load draw an ordinate to this curve. The length of the ordinate at any load, according to the scale used in drawing the unit ordinate, multiplied by the load equals the reaction from that load at the support without the pin. Distances above the line joining supports are plus and distances below are minus, and the algebraic sum of the reactions from the separate loads is of course the total reaction. In a similar manner reactions may be found at each of the remaining supports. Uniform loads may be divided into few or many concentrated loads, according to the degree of accuracy required.

This method is based upon the fundamental principles: First, that loads and deflections are directly proportional; and second, the Maxwell theorem of reciprocal deflections. The latter is applied to the beam with one support considered removed. For example, the reaction at R_2 for unit load at that point is unity, and is represented by the unit deflection. If, instead of a deflection of unity at R_2, any other deflection occurred at this point, the corresponding reaction R_2 would be equal to this deflection (times unity). According to Maxwell's theorem, the deflections at R_2 due to unit load in any position are given by the deflected position of the spline under that unit load. Hence the deflected spline with unit deflection at R_2 is the influence curve for the reaction R_2 due to unit load moving over the beam, provided the spline be of uniform cross-section and perfectly straight in its unstrained position.



REACTION FOR CONTINUOUS BEAM BY MECHANICALLY-DRAWN INFLUENCE LINES

In the example herewith the reactions R_1, R_2, R_3 and R_4 obtained from the curve are 7530; 34,150; 6190, and 12,880, while determined by the analytical method they are 7392; 34,304; 6782, and 12,524 lb. A closer agreement of the mechanical with the analytical method could have been obtained if the horizontal distances had been drawn to a larger scale (vertical scale unchanged).

Professor Beggs used a 10-ft. pole and nails, on a floor, to check the influence lines of the triple-span continuous-truss bridges on four supports of the Bessemer & Lake Erie R.R. over the Allegheny River near Pittsburgh. (This bridge is illustrated in *Engineering News-Record* of Feb. 22 and Mar. 15, 1917.) In an hour he checked within 1% results that had taken several days to determine by analytical methods.

Factors in the Selection of Pumps for Small Water-Works

Operating Economy Important Because of Financial Limitations—Various Types Reviewed—Some Cost Comparisons

Changes in type, the number of types now available, and the urgency for economy in water-works of limited resources, all combine to make timely and important the paper on "Engines for Small Water-Works," by Henry A. Symonds, civil engineer, Boston, Mass., printed in the "Journal of the New England Water Works Association" for June, 1919, and abstracted below.—EDITOR.

IN DESIGNING a plant for pumping water for a small community, it is usually the case that the per capita cost of operating and maintenance is greater than in the large city plants, and it is important that a careful study be made of the relative merits of the different forms of power available, their adaptability, first cost, and efficiency when operating to do the particular work desired.

It is usually the case that strict economy must be practiced in the introduction of these works, and studies relative to first cost have usually been made to bring the cost of the work within the ability of the communities to pay. Not so much attention, however, has been paid to the question of relative efficiency and daily cost of operation, and it frequently occurs that plants are in operation which the citizens of the town, and even the water-works officials themselves, believe to be highly economical, and that are the reverse. The difference in cost of operation may be so great as to make it good business to pay a much higher price for an economical unit.

Water Power—The early use of power for pumping water in the small-town installations was largely by water power or steam, and it is possible that water power is coming back into use for pumping purposes, but probably through the medium of the hydro-electric plants, as it is not common to find good water privileges so located as to be directly available for pumping from the approved sources of water-supply.

Steam Pumps—Steam has been used for many years very efficiently in many small plants.

Steam Turbines—The development of the centrifugal pump, which has now found so wide a field, was closely identified with the bringing out of the steam turbine.

THE IDEAL SMALL PUMPING PLANT

The centrifugal pump has been known for a great many years, but for a long time after it was invented the difficulty of getting suitable drive with sufficiently high speed retarded the development of successful operation of this type of pump. The real growth of this pump has occurred in the past ten years, during which time the use of the steam turbine and the electric motor with direct connection to the centrifugal pump has brought up the efficiency of the pump to a relatively high stage. At the present time the use of the steam turbine as applied to pumping water is mainly in the large units, and the motor is generally adopted for driving the smaller plants.

The result of the use of steam is, on the whole, satisfactory, but for the small water plants it is subject to the objections that the economical pumping machines with boilers are expensive and occupy much space, and provision for large storage of coal and adequate pumping-station buildings are required, all of which conditions add to the first cost of the plant and are aggravated by the fact that licensed engineers are required to operate such a station.

Today we consider the ideal small pumping engine that which is economical in first cost, and is self-contained; i.e., operates from a source of power which is part of the engine or at least located in the same station. It is desirable to have it occupy as small space as is practicable, be simple in operation and not require the services of licensed men, easily repaired, quickly started, using fuel which is readily available at all times, and be capable of producing power at a relatively low unit cost.

Electric Motor—Many of the conditions of an ideal plant are met by the electric motor, and the electrical installation has become more and more common. The advantages are: Low first cost; it requires little space; low cost of maintenance; no expert supervision; it is especially well adapted to drive centrifugal pumps with direct connection, which saves friction loss of gears, and prevents noise; it may have automatic control; it may operate during periods of low load at central station, thereby getting lower rates; instant starting; as it has no reciprocating parts, it can be left to operate without attendance better than any other form of drive. The use of electricity has two serious defects in the average municipal plant; namely, it is not self-contained, but depends upon a line of wires and a power plant, usually at a distance, for its operation. For this reason neither one nor two units in a pumping station operated from the same plant are satisfactory to the insurance authorities, as they rightly claim that an accident to the wire line or the power plant will put both units out of use as quickly as one and leave the town or city in an unprotected condition in case of fire.

ATTENDANCE THE LARGE ITEM OF COST

The advocates of the use of motors base their claims of low cost of operation upon the fact that attendance may be a minimum and that this is really the large item in operating small water plants. The writer believes that this argument has considerable merit, and that the improvement in efficiency brought about recently in the centrifugal pumps, and the low cost of the pump and motor, with the advantages above referred to, make this form of pumping plant a very close competitor of, and in some cases it will be found actually to be a better business proposition than, the other types of pumps and engines in spite of the difference in efficiency.

Gasoline Engine—Another form of drive which has been used in some of the small pumping plants is the gasoline engine. This form of power has practically all the advantages above mentioned except cost of operation, and in this it falls down badly, as it is operated upon a fuel of such high cost as to make the operation per horsepower-hour too high for practical purposes in the ordinary municipal water-works. However, in plants where an emergency unit is wanted and electricity is not available or desirable for any reason, the gasoline engine may meet the requirements in a satisfactory manner.

Producer Gas—The gas producer as a source of power corresponds to the boiler in a steam plant. It has

a great many advantages, and when combined with a proper engine for utilizing the gas to the best advantage may be considered as having most of the requirements of the ideal plant. This form of power has been used for some time, and, so far as the writer has record, with good satisfaction in all cases. Gas produced in this way may be used in various types of internal-combustion engines with slight modification. A plant of this kind can be installed at reasonable first cost, is self-contained in so far the power is generated directly next to the engine itself, and operates at a remarkably low cost upon a relatively inexpensive form of coal. The plant takes up more room than some of the other types, and calls for a larger pumping-station space.

Fuel-Oil Engines—In the writer's experience, in nine cases out of ten fuel-oil engines have proved an ideal installation for plants from 25 to 150 hp., and for this reason it may be proper to give some extra details regarding this engine. The term "fuel oil" is here used to mean any oil, from the heavier crude petroleum up to kerosene.

Fuel-oil engines are to-day known under two general heads as Diesel and Semi-Diesel, or surface ignition.

Semi-Diesel Engines

The idea conceived by Diesel is the bringing into compression a mixture of air and oil vapor to a point where heat is generated sufficient to ignite the combination. The compression reached varies from 500 to 1100 lb. per square inch, but when the proper temperature occurs the gases burn rather than explode, and it is the claim of the producers of the Diesel type that this slower burning conserves the power of the gases, and the energy realized is utilized almost entirely in pushing the piston through the length of its stroke. In order to permit of the great pressure produced by this process, the machine must be exceedingly heavy, and the great amount of work which is required to perfect the Diesel engine makes it too expensive for the ordinary requirements of small water-supply plants.

The Semi-Diesel, or surface-ignition engine, on the other hand, gets its power by the explosion of a mixture of air and oil gas in the cylinder under compression around 200 to 300 lb. per square inch. While part of the energy is undoubtedly used in the shock against the metal of the plunger and cylinder, the resulting thrust produces motion of the piston, which is connected through the crosshead, or directly to a crank shaft which gives the motion to the driving pulley or gear.

The Semi-Diesel seems to meet all the ordinary requirements of the ideal engine described above, and while the first cost of this engine is considerably greater than that of the gasoline engine or the electric motor, the operating costs are so low that this outweighs in most cases the advantages of the low first cost of the other machines.

In the types which are considered as small pumping outfits, designed to pump the water for communities of from 1,000 to 10,000 inhabitants, the engines required ranged from 25 to 150 hp., but in the writer's opinion there is a large field for a still larger oil engine, and there are some machines now being produced that show wonderful efficiency in operation. They are of the Semi-Diesel type, but are able to operate on the poorest grade of fuel oil, and even tar products which have to be heated before it is possible to get them into the cylinders. The oil used runs as low as 18° Beaumé, while in the smaller machines—that is, below 60 hp.—the writer knows of good results with oil heavier than 26° Beaumé, and with 25- to 35-hp. engines kerosene or light oils of that grade have seemed to give the most satisfactory results. Pre-war prices ranged from 2c. to 7c. for the various grades.

The ordinary time of starting with fuel oil is from 12 to 18 min., but engines of this type may be equipped with apparatus which permits of instant starting by electric ignition and gasoline, the fuel oil being turned on after a few minutes, without interruption of the operation of the engine. This latter contrivance is of especial value where but little storage of water is possible and pumps have to be operated in case of fire, as the delay in heating the cylinder head may be serious if the supply of water is not available.

Electric Motor Versus Oil Engines

It is claimed by the advocates of the electric motor, in comparison, that the motor requires little attendance, while the oil engine calls for constant supervision. This claim is not entirely substantiated in practice, for many of the oil plants are operating for long periods of time without attendance. This of course assumes that there are duplicate units which will take care of any fire hazard if repairs are necessary. It should also be considered that constant attendance does not eliminate many of the breakdowns.

Perhaps the most satisfactory combination that can be installed for a small pumping plant for general municipal needs is made up of two duplicate units, of which it is probable that the fuel-oil engine meets the needs fully as well as any other drive which has been developed up to this time.

One advantage, of considerable importance in some cases, that steam machines have over most of the other types is in the varying of speed in operation. The speed in the electric motor and of the internal-combustion engines is variable only to a small extent, ex-

COMPARATIVE FUEL AND FIRST COSTS OF VARIOUS TYPES OF PUMPING PLANTS FOR SMALL WATER-WORKS

1,500 g.p.m., 250-ft. total head; operating 300 days per year, nine hours per day; theoretical hp., 94.7.

Pump	Drive	Pump Efficiency Per Cent.	Hp. Required	Cost of Fuel per Hp. Hour	Total Fuel Cost Per Hour	Total Fuel Cost Per 300 Days	Estimated Cost of Plant	Remarks
Vert. triplex	Fuel-oil engine	85	112	$0.004	$0.498	$1,209.60	$17,189	Guarantee—1 hp. for 0.55 lb. fuel oil per hour. Price fuel oil, 4c. per gal.
Centrifugal	Fuel-oil engine	71	134	0.004	0.536	1,547.20	16,343	
Vert. triplex	Steam turbine	85	112	0.0075	0.840	2,268.00	13,657	Coal at $6 per ton (2,000 lb.)
Centrifugal	Steam turbine	71	134	0.0075	1.005	2,713.50	9,957	
Vert. triplex	Electric motor	76	123	0.0124	1.55	4,185.00	11,116	Efficiency is combined pump and motor. Electricity cost, 0.9c. per hp.-hr. plus "service charge" of 77c. per hp., based upon max. hp. in use, per month.
Centrifugal	Electric motor	64	148	0.0124	1.84	4,968.00	6,248	
Cross-compound, fly-wheel, steam pumping engine						1,350.00	17,000	
Compound-duplex-Deane steam pump (original plant). Rate about 700 g.p.m.						2,725.61		Actual figures of present cost. Rate of pumping about 700 g.p.m.

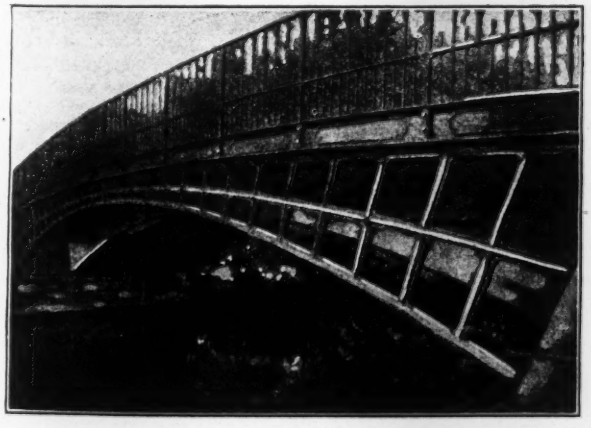
cept by change gears or belt pulleys, and it is sometimes necessary to pump to waste or through a bypass back into the suction, an uneconomical process, in order to keep the rate of delivery as desired.

The writer had occasion, a short time ago, to make a comparison of different types of pumping plants, to determine which plant would best meet the needs of a community. In connection with this, the results of investigation of different units were tabulated and are here given (see page 431). The figures are not to be considered as exact, either of operation or first cost, but are obtained by using quotations and guaranteed efficiencies by the manufacturers of the different lines of machinery. These figures were also taken before the extreme rise of prices which has occurred since we entered the war, and, while they are far above the averages of five years ago, it is probable that they are nearer what we may expect in the next few years than pre-war prices.

Historic Arch Bridges Strengthened

AS DESCRIBED in a short announcement in *Engineering News-Record* of July 17, 1919, p. 134, two historic cast-iron bridges in Shropshire, England, built by Thomas Telford nearly a century ago, have been strengthened for modern traffic. The four-rib arch structure in the parish of Stokesay, between Shrewsbury and Ludlow, was found to have two of the cast-iron ribs fractured at various points, as illustrated in the diagram herewith, reproduced from an article by the designer of the reinforcement, Major A. T. Davis, in the *Surveyor* for July 4, 1919, p. 3. The following details of the work are taken from this article:

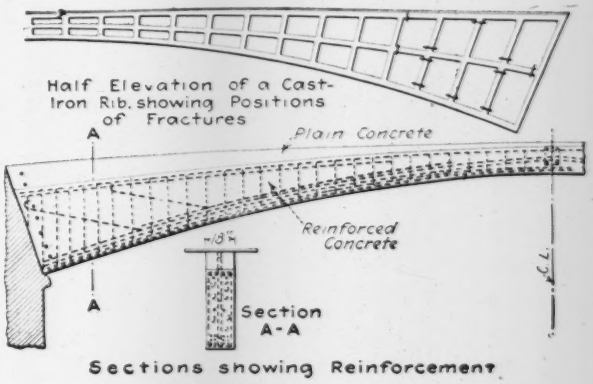
Various methods of making repairs were considered. Strengthening by flitching of fishplates was regarded as out of the question, partly because of the difficulty of boring rivet or bolt holes in the cast iron without causing undue weakness, and partly because of the difference between the elasticity of cast iron and of mild steel or wrought iron; more especially, however, because such treatment would not have increased the weight-carrying capacity of the bridge beyond that of its strength before fracture, which was certainly unequal to the requirements of the present day.



OLD CAST-IRON ARCH BRIDGE BEFORE INCASEMENT

As no evidence of damage was found in the two outer ribs, these were left untouched, thereby avoiding any noticeable alteration in the appearance of the structure. The two center ribs were incased in reinforced concrete, 18 in. wide, as shown. At the center of the span their width is increased to 3½ ft. at the top, and they are braced transversely by a 12 × 14-in. horizontal member.

The work was executed by the use of staging suspended from the outer ribs, the timbering being long enough and rigid enough to carry the weight of the concrete. It was also secured to the structure laterally for resistance to any flood pressure, owing to the fact that the River Onny is subject to sudden floods. The original intention was to strengthen one rib at a time, to enable the bridge to be used for ordinary light traffic first on one side and then on the other. Finally, however, it was thought better to avoid all vibration by diverting the traffic to a by-road a short distance away, and carry on the work on both ribs simultaneously. The bridge is now capable of bearing a rolling load of 30 tons on a 10-ft. wheel base.



METHOD OF REINFORCING WITH CONCRETE

The other, or Cound bridge, carries the main road between Shrewsbury and Wenlock across a tributary of the River Severn. In this case, also, two of the cast-iron ribs were incased in reinforced concrete.

The strengthening work was carried out in both cases under the plans and superintendence of Major Davis by Messrs. L. G. Mouchel & Partners, Ltd., of Westminster, England.

Motor-Vehicle License Fees in Massachusetts

Recently the legislature of Massachusetts enacted a motor-vehicle law in which the following license fees were established:

Capacity of 1 ton or less	$10
" 2 tons and over 1 ton	20
" 3 tons and over 2 tons	30
" 4 tons and over 3 tons	40
" 5 tons and over 4 tons	50

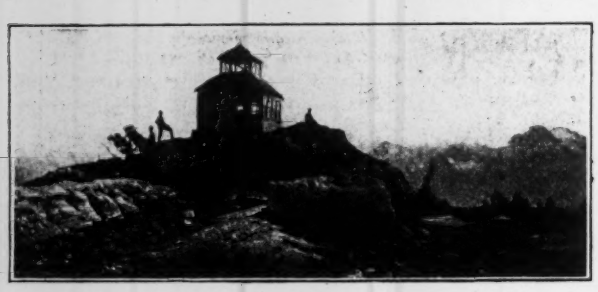
Note. For any capacity over five tons, $50 for the first five tons, and an additional amount of $10 for each additional ton or part thereof.

For all commercial trailers equipped with non-resilient metal tires, double the above fees shall be collected, and for electro-motor trucks and electric commercial vehicles used solely as such, and for all commercial trailers equipped with pneumatic or resilient metal tires, one-half of the above fees shall be collected. For the purpose of this act, the term "trailer" does not include a pair of wheels commonly used as an implement for other purposes than transportation.

Standard Lookout House Adopted for Forest Fire Service

THE North Pacific district of the United States Forest Service has adopted a standard house for construction on high lookout points and has erected eight such structures, the highest being that on Mount Adams, which has an elevation of 12,307 ft. The essential features of the house itself are a main living-room, 12 x 12 ft. with a band of glass windows on all sides, and a cupola 6 x 6 ft. in the roof, also surrounded by a band of glass, in which are placed necessary instruments and equipment for observation and report.

As a result of previous varied experiences, the conclusion has been reached that the only satisfactory type of house is one located on the extreme summit, which provides the lookout observer not only with a comfortable home, so that he is able to be on duty at all hours throughout the fire season, but which also enables him to keep under constant observation the area surrounding the station.



STANDARD LOOKOUT HOUSE, WASHINGTON NATIONAL FOREST

The walls and floors of the standard building are of double construction. Much more care is necessary in erection than with ordinary buildings, since driving rainstorms frequently occur at mountain summits and force water through cracks and openings never discovered in ordinary situations. Most of the houses constructed were shipped from Portland, Ore., ready-cut and fitted for erection, the various timbers and boards being cut into short lengths and tied into bundles convenient for packing. Only two pieces are longer than 8 ft., these two being 2 x 6-in. timbers 12 ft. long. The average weight of such a ready-cut lookout house bundled for shipment, and including hardware, bolts, guys for cable, nails, etc., is approximately 6400 lb. Each piece is lettered or numbered, and the corresponding letter or number is placed upon a blueprint for the guidance of the constructing officer. The house is guyed by cables attached to each corner.

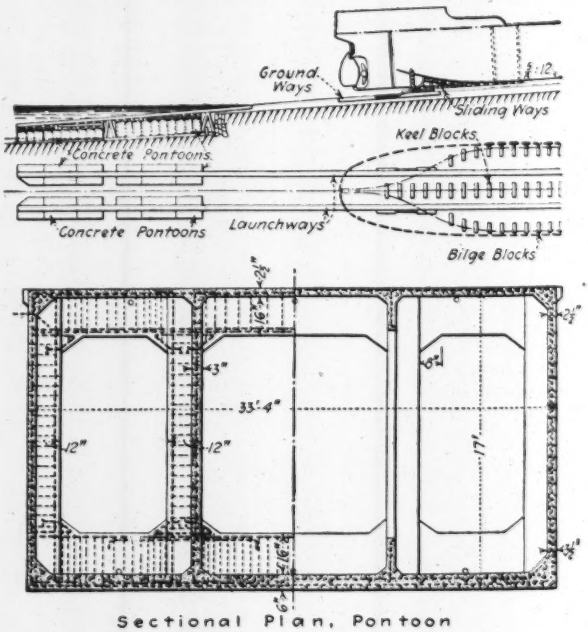
Ready-cut houses have already been completed, or nearly completed, at Mount Adams, El. 12,307, and Mount Saint Helens, El. 9675, in the Columbia National Forest; Kiona Peak, El. 6100, Rainier National Forest; Windy Peak, El. 4920, Mount McLaughlin, El. 9760, and Rustler Peak, El. 6200, in Crater National Forest; Huckleberry Mountain, El. 5500, in the Cascade National Forest.

The Rustler Peak house was placed upon a 12-ft. steel tower, the top of the mountain being somewhat round so that this additional elevation was necessary to obtain a good view in all directions.

The value of mountain lookouts as a means of detecting and locating forest fires has been thoroughly established by the Forest Service. The lookout man on the summit of Mount Hood (El. 11,225), in the Oregon National Forest, reported 56 fires in 1916 and 64 in 1917. On two occasions campfires at the base of Mount Adams, 55 miles away, were discovered and correctly located. In 1917 all but five of the fires between Mount Jefferson and the Columbia River, a distance of 80 miles, were discovered and reported from the Mount Hood lookout. These five were small campfires left unextinguished but discovered and put out before gaining any headway.

Concrete Pontoons Form Water End of Launching Ways

CONCRETE ships are being built at Barrow-in-Furness, England, by the Ferro-Concrete Ship Construction Co., Ltd., at a site where the quay is about 10 ft. above the rock-bottom bed of the channel and where the high-tide level slightly overtops the quay wall. In order to take care of the outboard end of the launching ways, it was decided to use concrete pontoons in the location and of the general design shown in the accompanying drawing. Four of these pontoons were built, 33 ft. 4 in. long, 17 ft. wide and 10 ft. deep, with the general framing details shown in the drawing. These pontoons are floated into place at the end of the ground ways, and after being adjusted in position are flooded, the quantity of water admitted being sufficient to prevent them from being shifted by successive tides. When the pontoons have to be moved the water is allowed to drain out at low tide, and they are floated to a new position on the next rising tide. The pontoons are moved from way to way as required for launching. An article describing the yard and the numerous concrete craft, consisting of 1000-ton barges, 1150-ton ocean-going steamers and 750-hp. steam tugs, appeared in *Engineering* for May 16, 1919, in an article by W. N. Twelvetrees.



CONCRETE PONTOONS FOR OUTBOARD END OF END-LAUNCHING WAYS

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Three Openings to One Graduate

Sir—I note in *Engineering News-Record* of July 17, 1919, p. 141, a letter by F. N. Harris, entitled "Stop College Supply of Graduate Engineers."

Perhaps Mr. Harris does not know that for several years now there have been about three openings for every college graduate in engineering. We have usually had, here at Michigan, 200 graduates a year and from 500 to 600 applications. This year we had less than 100 graduates and probably 250 or 300 applications. What is true of Michigan, I assume to be also true of the other engineering schools.

Graduates who used to receive from $45 to $75 a month now receive from $125 to $200. The indications are that the numbers coming to engineering colleges next year will be larger than ever before.

M. E. COOLEY,
Dean, College of Engineering, University of
Ann Arbor, Mich. Michigan.

The Development Committee's Report

Sir—A close survey of the proposed items of "reform" in the report of the committee on development of the American Society of Civil Engineers shows that the society is to go on record as strongly urging the engineer to enter into the civic and political life of the nation, with the one aim of purifying and dignifying it. W. W. K. Sparrow in the July 17 issue of your journal said that two of the reasons why engineers are not appreciated were "lack of activity in public affairs, and lack of publicity concerning the engineer and his worth and his relation to the better health, comfort and welfare of the community."

Along this particular line, the writer suggests that each of the local associations have a publicity bureau. The parent body cannot advertise local material to a local citizenry. Any publicity effort must be intensive and thorough, and consequently the territory covered by any one local unit must be limited in size

Chicago, Ill. R. E. SPEAR.

How May the Young Engineer Receive His Training in Technical Writing?

Sir—As a recent graduate in engineering, and having a desire to keep in practice in technical writing, the problem faces me, "How to do it." The engineering magazines are apparently reserved for the older members of the profession—those who have spent a life of concentrated experience and are now telling their stories—and those in fewer number who write as they work. How did these men bridge the period between graduation and the "day of reckoning" when they felt they had something worthwhile to tell other engineers? Was rust allowed to gather upon their literary attributes, during the formative period?

Our attitude in college toward language courses, especially English—in fact, toward anything outside of strictly engineering subjects—is, "They are a waste of time." If a channel existed through which the technical literary aspirant might express himself after graduation, would not the interest in the writing of correct English in technical schools be stimulated? Would not the general level of engineering writing by engineers be elevated thereby?

The engineer, we are told, does not rank socially with members of other professions—to name two, those of law and medicine. His name seldom appears in the daily news, as does that of Lawyer Smith who wins a popular verdict for his client Jones. All the more reason why the engineer should give a good account of himself the few times he does appear before the public. May not the young engineer look to the older members of the profession for light and guidance in vitalizing interest in the English language e'er the "English ain't no use nohow" methods become crystallized?

Boston, Mass. J. WENDELL MOULTON.

[The way "to do it" is to do it and keep doing it. The engineering graduate—and, for that matter, the undergraduate as well—should seize every opportunity that comes his way, and should go out of his way for opportunity, to describe engineering studies and construction and express his thoughts on professional matters, and on such public questions of the day as his education and training qualify him to discuss with sound reasoning. To make such writing vital and appealing it should be addressed to some circle of readers in each case, even though it be an imaginary circle.

It is a mistake to assume that there is any lack of channels for anyone with useful information or inspiring suggestion. The technical press, engineering societies, the daily press, civic and commercial organizations, all afford an outlet. It is a bigger mistake to suppose for a minute that any public medium can long be maintained for utterances that contain neither information nor inspiration.

Finally, if either engineering students or young engineers in practice wish to be able to write clearly and appealingly, they must never cease reading the best masters of English, whose writings not only serve as a model of expression but give that breadth of mind and culture which many engineers lack so sadly.—EDITOR.]

Transit or Plane-Table for Topography

Sir—Referring to the query of Hargraves Wood (*Engineering News-Record* of July 10, 1919, p. 95) as to the relative advantages of using a transit or a plane-table for topographical surveying, I note your issue of Aug. 14, pp. 332-333, contains three answers to his question, which is not clearly stated. By transit, no doubt, stadia is meant. There is a vast difference between making a topographical survey of a large area and running a preliminary line for a railroad. For the former a stadia transit and a plane-table are well fitted, and if the area is a large one, elevations with a Y-level are usually taken at governing stations or points, to check up the stadia work.

As F. J. Howes says, "railroad surveys cover a comparatively long and narrow strip of ground," and if the preliminary line is skillfully run, extensive width of topography is not needed. Thousands of miles of railroads in the United States have been built on the surveyed lines of which not one foot of topography was

taken. In my opinion, the use of a plane-table for taking topography along a railroad survey (not a reconnaissance) is not defensible; in fact, it would not be used at all in wooded country. Mr. Howe also says, "a plane-table will give accuracy greater than that obtained by common methods." This I also desire to controvert. I cannot conceive any greater accuracy than that of obtaining contours by hand level and graduated rod in cross-section lines, working from known center-line elevations. On cleared ground a clinometer will give fair accuracy if special care is used.

On the Guanajuato branch of the Mexican Central Ry., with which I was associated, all the contour maps were made in the field. The surveyed line was plotted on sheets 19 x 24 in., on a scale of 1:2500 metric system, which was required by the Mexican Government. Contour intervals were 2 m. From the level elevations, contours ending in 2 and multiples were spotted along the center line. These maps were taken into the field and pinned to a light drafting board, and by means of straps were fastened to the back of a Mexican peon, who served as a perambulating easel. Contours were drawn in as fast as taken, and all natural and artificial features were also plotted.

To sum up, methods must be used which will suit the particular kind of work to be done. I would suggest to Mr. Wood that he procure a copy of the paper, published by the American Society of Civil Engineers, entitled, "Recent Stadia Topographic Surveys, Notes Relating to Methods and Cost," and listed as No. 880.

Buffalo, N. Y. EMILE LOW.

The Electric Railway As a Freight Carrier

Sir—If it is not too late, an addition may be in order to the article by Charles Whiting Baker in your issue of July 10, 1919, on "Freight Transport by Railway and by Motor Truck." On reading this article, I was struck by the fact that, despite its comprehensive treatment of steam railroads and motor trucks, so little was said about either the interurban or the urban electric railway's performances and possibilities in this field. Indeed, the only reference consists of a few lines under the heading, "Electric Traction Not Feasible for Light Traffic," and no cognizance is taken of the fact that there are thousands of miles of electric interurban railways on which goods are handled, from the extensive interchange of standard freight cars down to the smallest express package. Some survey of the achievements of electric railways appears all the more essential because of the position that they occupy midway between the trunk-line steam railroad and the neighborhood motor-truck service.

Although American city railways have not given the same attention to the carriage of parcels as have their British brethren, the American interurban railway has made far greater strides in the carriage and interchange of freight. Strictly speaking, the average American interurban is simply a railroad of the same gage as, but somewhat lighter construction than, its older steam brother; while a number are right up to steam-railroad standards. The chief obstacle to their fuller coöperation with steam railroads, which could more frequently use them as short-line, terminal or distributing railroads, is the still rankling prejudice remaining from the days when the electric interurban builder blithely cut his passenger and freight rates below cost. For all that, thousands of cars are interchanged with steam railroads annually on such systems as the British Columbia Electric Ry., the Pacific Electric Ry., the Illinois Traction System, the Detroit United Ry., the Fort Dodge, Des Moines & Southern Ry., etc. This interchange business, of course, is entirely aside from local less-than-carload or even carload traffic. As for the handling of express parcels, the Electric Express Co. coöperation of interurban electric railways in this field. Any number of electric railways have contracts to carry of Cleveland, Ohio, is an almost venerable example of the packages for the old-line express companies, while properties like the Connecticut Co. have built up a very large short-haul business based upon the principle of short headways.

When, in 1918, our steam railroads were jammed with war traffic, it occurred to a number of us that it would be desirable to see what relief the starving electric railways might afford to parallel steam railroads by taking over some short-haul passenger and freight business. It cannot be said that the steam railroads were very enthusiastic when they were asked to shunt their overflow to their electric neighbors, although the data gathered by A. B. Cole showed that the electric railways could do much, despite their inability to permit through running for more than a few hundred miles. In fact, at least one electric railway, because of old antagonisms, was unwilling to serve as a link in such through service!

The investigation conducted by Mr. Cole during 1918 showed conclusively that electric railways were not only doing a great deal of goods business, but that they could do still more, provided that more through runs were possible; that motive equipment specifically designed for freight service were used and, most important, that the electrics grasped the many opportunities *not* overlooked by the wideawake motor-truck operator. Those who wish to study this subject in more detail will find this necessary complement to Mr. Baker's article in the contribution by Mr. Cole entitled "Electric Railways Are in a Position To Haul More Freight," published in the *Electric Railway Journal* for May 11, 1918, and distributed in pamphlet form by the American Electric Railway Association, New York.

Just as the electric railway cut into the short-haul business of the steam railroad, so has the motor truck cut into the business of the electric railway. It goes without saying that the convenience of door-to-door delivery afforded by the motor truck often offsets, for 25 to 50-mile runs, its higher charges for carrying goods where time is of the essence of the contract. Nevertheless, a large proportion of present motor trucking is economic waste. You can carry hundreds of thousands of tons of freight over an electric short-line railway and the rails will show no perceptible signs of wear; while the same amount of traffic hauled *at a lower rate of speed* by motor truck will ruin anything but a concrete roadway. The public, not the carrier itself, pays for this waste.

As an example of what a really live electric railway can accomplish on so short a haul as 12 miles, I will quote what the Interurban Ry., of Des Moines, Iowa, did during the war in furnishing Camp Dodge with all needful supplies. This railway hauled over 10,000 standard freight cars, totaling 500,000 tons of freight, in 1000-ton to 1500-ton trains of 20 to 30 cars each at ar

average speed of 15 to 18 miles an hour! There were but four men to the train, so that the haul per man was a mere 250 to 375 tons per trip. Had this job been assigned to motor trucks, each driver surely would not have averaged better than five tons per trip. To haul 500,000 tons, fully 100,000 men-trips would have been needed, compared with 1666 men-trips (assuming 300 tons per man) via the electric railway. In other words, if the motor trucks could have equalled the speed of the electric railway, they would still have required 30 times the man-power. And what would the best of Roman roads have looked like after 100,000 motor-truck runs?

I am well aware that the contrast would be more favorable to the motor truck in cases where the collection and distribution of the material is of retail character. However, I have quoted this instance, and mentioned other examples of electric-railway performances in handling of freight, chiefly to bring out the fact that the electric railway is a factor which must be respected by both the steam railroad and the motor truck, competing as it does for bulk freight with the former and for package freight with the latter. The engineer and the economist should try dispassionately to determine the most efficient uses of each, paying due regard, of course, to the great emergency value inherent in the self-propelled vehicle because it can be sent anywhere at almost any time.

WALTER JACKSON,
Consultant on Electric Railway Service.
Brooklyn, N. Y.

The General Staff's Army Bill

Sir—Permit me a few words in reference to the article, "General Staff's Army Bill Strikes at Corps of Engineers," and your editorial comments thereon, in your issue of Aug. 21.

One's attitude towards this bill depends somewhat on one's conception of what the General Staff is and of the functions of the Corps of Engineers. The General Staff is conceived to be the brains of the Army, its personnel not being permanent and being selected by an impartial board from the ablest officers of the various arms of the service, including the Corps of Engineers. If this is done so that specialists are available to advise on all technical matters relating to their arm or corps, including the Engineers, one can see no harm in such a body formulating an order to enable the Chief of Staff to command the Army under the direction of the President and the Secretary of War, as someone must do this and the Chief of Staff is helpless without a staff to advise him.

As to the functions of the Corps of Engineers, this body, like the Signal Corps, can accomplish nothing alone, and clearly it is an accessory to the combat troops, and particularly to the infantry, whose servant it is, and, to a less extent, to the artillery also. If these conceptions are correct, there can be no other conclusion but that the Corps of Engineers should be directed by the same body that commands the rest of the Army.

As to the relations of the staff and the line, this is an old problem, and to carry out the suggestions in this article would carry the Army back twenty years, when we fought a war without a General Staff and with permanent staff departments each acting independently, and we all know the result. We have only to compare the confusion and scandals of the Spanish War with the results obtained in this war, to decide which is best.

Since the Spanish War, military legislation has been directed toward eliminating permanent staff officers, and except in the Engineer and Medical Corps, there are very few of them left, and staff positions are now filled by temporary details from the line. Time was when the Army had only one battalion of engineer troops, so that all field officers in the Corps of Engineers, with the exception of one major, were staff officers, but with the regimental organization of engineer troops, authorized by the national defense act of June 3, 1916, and the regiments of engineers, more than 25 in number, contemplated by the act now under consideration, it is not likely that the Engineers will suffer on account of the provision of the act making staff officers ineligible to promotion to general officers.

It is true that under this act a general officer, trained as an infantryman, could be assigned to command the Corps of Engineers, but it is not likely that this will be done, as we must assume that the Army will be administered with the same intelligence and common sense that prevail in civil life.

The Army under its general officers, assisted by their staffs, has ended the war and has handled a problem of great magnitude and difficulty, and deserves great praise instead of censure. One cannot deny that mistakes were made, that square pegs were forced into round holes, and that many technical men of high standing in civil life were not used to the best advantage, and consequently, feel that their talents were not apreciated. But the bodies of too many boys remain over there, and too many have returned with permanent disablements, for the country to pay much attention to those who only had their feelings hurt.

The remedy is not obstructive criticism, but assisting the country to obtain a military policy that will enable the technical men of civil life, who are to assist the Army in war, to be trained with their professional fellows in the Army in time of peace, so that they will learn to work together and to appreciate the abilities of each other, and thus eliminate friction and the lack of confidence.

GEORGE D. SNYDER.
New York City.

Salaries for Technical Instructors

Sir—It is not often that I pay much attention to the "Positions Wanted" columns of *Engineering News-Record*, but the recent controversy in your pages concerning engineers' salaries has compelled me to scan them frequently of late. In the issue of July 31, just at hand, I find the inclosed:

> INSTRUCTORS wanted: The College of Engineering of the University of Illinois is in need of several instructors in steam engineering and mechanical engineering laboratory practice; one instructor in railway mechanical engineering; one instructor in ceramic engineering; one instructor in highway engineering; and two instructors in general engineering drawing at salaries of $1500 to $1800 for ten months. Technical graduates having some practical and teaching experience desired. Inquiries should be accompanied by a complete statement of training and experience, a recent photograph and a list of references. Address Dean C. R. Richards, University of Illinois, Urbana, Illinois.

This I think is *well worth a full page display* in your reading matter columns, so that he who runs will be compelled to read it. I cannot understand how Dean

Richards of one of the best known and top-notch engineering colleges, the College of Engineering of the University of Illinois, has the nerve to sign his name to such an advertisement and then turn around and solicit students for that school.

Frankly now, would you care to send your son to school to be instructed in such a science as engineering and expect him to acquire any knowledge, except such as he could dig out himself, at the hands of a professor of that science competent to earn only $150 per month for ten months in the year? I think not, and I know that I would not. When I went to school I looked upon the teacher or professor as the essence of practical knowledge—and here is a great university dispensing it at $150 per month, and evidently the second figure of $180 per month is the maximum any individual in the whole faculty can look forward to. If that advertisement could be placed in the hands of the fathers of the boys who expect to take those courses this year, I fully believe that the practical fathers would reduce the attendance by 50% without batting an eye.

I have in the past had a high opinion of the University of Illinois' engineering department, and on numerous occasions have recommended that school to aspiring students; but never again, at least not until it is willing to pay a price that would induce real talent to enter the teaching of this noble science.

Unfortunately, this school is not the only one which has so low an opinion of the value of such services, for other advertisements of a similar nature appear in the same columns. I should think the editor of the Searchlight section of *Engineering News-Record* would feel ashamed to accept such an advertisement from such a school, unless it could name a price commensurate with the qualifications required.

Some of your correspondents, in discussing engineers' wages, have held the term draftsman in contempt, but let me tell them that during the past winter boys with only a high-school drafting course have been filling jobs all over the country as draftsmen—yea, verily, they were hardly fit to be called tracers even, and pulling down $150 per month. And employers were glad to get them. I can name many such young men, who have no idea of what an engineer really is, who are getting wages supposed to entice the talent of the land to teach.

CARL H. FULLER.

Mobile County, Alabama.

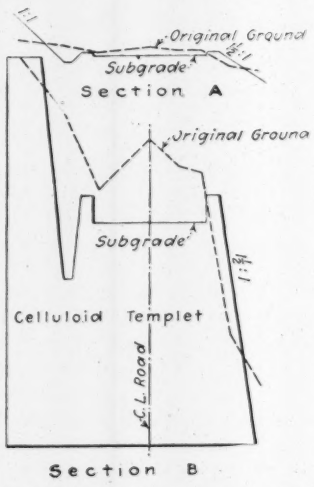
Exaggerated Cross-Sections Measured by Planimeter

Sir—In preparing plans for highway work, one of the most tedious tasks is balancing a grade line and computing earthwork. The practice in this office is to plot cross-sections, and, using a celluloid templet, draw the outlines of the finished road thereon, obtaining the end areas by means of a planimeter. This method has been satisfactory, in general, but it has been found that in cases of light cut-and-fill, as in paving or reconstruction of existing roads, the scale usually employed of 10 ft. to 1 in. vertically and horizontally, does not always give satisfaction, and areas obtained by the planimeter vary, by a percentage too great to be ignored, from those obtained by direct calculation.

To obtain accurate results, where the cut or fill was but a fraction of a foot, required rather closer platting and more accurate handling of the planimeter and templet than are usually obtained from the average draftsman. With a view to obtaining closer results and of giving greater freedom of action in the use of planimeter and templet, the writer suggested the use of exaggerated cross-sections and templets, and, in practically all work of the present season involving over 20 miles of paving, this has been done. The results have been very satisfactory, and to date no serious complaint has been made by contractors or others concerned in the construction of these roads, that the computed quantities or distribution charts have been in error, beyond that to be expected from errors in taking levels or in estimating the shrinkage or swell factors.

The scales adopted are 10 ft. to 1 in. horizontally, and 1 ft. to 1 in. vertically. This permits the ready use of the standard 10 x 10 cross-section paper as before (only it must be kept in mind that each line in vertical scale represents $\frac{1}{10}$ ft.) and, furthermore, it allows the use of the planimeter with the same setting as for the natural scale of 10 ft. to 1 in., always keeping in mind to move the decimal point one place to the left in reading areas, the result invariably being 10 times the correct figure.

The accompanying sketch shows the same cross-section in both natural and exaggerated scales; an examination will show that a slight displacement of the templet or of platted points in Section B will have a great deal less effect upon the area than will the same displacement in Section A. At first glance the exaggerated section appears startling, but it has been found that after a day or so of practice even the most conservative draftsman becomes accustomed to its use. Everyone working with the system finds much relief, chiefly because of the ease with which a difference of $\frac{1}{10}$ ft. may be noted, and because of the knowledge that extreme care in tracing lines with the planimeter point is not so essential to accuracy.



NATURAL AND EXAGGERATED CROSS-SECTIONS

It is realized that the vertical scale adopted has a tendency to limit its use to roads where the cuts and fills are light, but the system may be found advantageous in cuts and fills not expected to be more than 6 or 8 ft.; primarily, however, it was intended for paving and similar work.

All work of the King County engineer's office is done under the direction of Samuel J. Humes, county engineer, and by his sanction the foregoing method was adopted for use.

C. P. MOWRY.

Seattle, Wash.

Design of Swimming Tank

Sir—In an article on the swimming tank in *Engineering News-Record* of July 17, 1919, p. 135, Mr. Viterbo says the tank bottom was designed for the hydrostatic head of 9 ft. 8 in., which gives a pressure of 600 lb.

per square foot on the tank bottom. This water elevation is, I judge, the overflow level. In addition to the above he has added a live load of 100 lb. per square foot for the swimmers. It seems to me when a swimmer gets into a tank he displaces an amount of water equal to his weight and causes the tank to overflow, thus preventing the increased bottom pressure assumed by the writer of the article.

San Antonio, Texas. M. D.

[In response to an inquiry, Mr. Viterbo explains that in the original design the depths were 11 ft. 3 in. at the high point and 6 ft. 9 in. at the low point, while the high-water level was 19 in. below the overflow level, so that when the tank was filled to the normal level, displacement due to the entrance of swimmers would not cause overflow. Hence the assumption that swimmers would produce a superimposed live load. However, after the building had been commenced the depths were changed to 9 ft. 8 in. and 5 ft. 2 in., respectively, but as this reduced the load no change was made in the assumptions for loading.—EDITOR.]

Water-Hammer in Penstocks and Economy of Design

Sir—Referring to the correspondence on the above-mentioned subject in your issue of June 19, 1919, p. 1222, I have been examining Minton M. Warren's formula, as given therein, in the light of the experiments of Camichel, Eydoux and Gariel. These were carried out on the penstocks of a hydro-electric plant at Soulom, France, in 1916.

It is evident from their results that this formula is gravely inaccurate. It is difficult to see why it should be adopted by engineers in your country in preference to the formula of Michaud, $h = \frac{2LV}{gT}$, which was first published in 1878. It is, of course, only applicable when $T > \frac{2L}{a}$, and when the closing of the gate is a linear function of time.

I inclose a table of experimental results extracted from "Des Coups de Bélier," by Camichel, Eydoux and Gariel (published by Edouard Privat, of Toulouse, France), and showing the water-hammer actually obtained, compared with that calculated by the Warren and the Michaud formulas. It will be noted that the water-hammer actually observed was in some cases more than 50% in excess of that given by the Warren formula.

OBSERVATION ON PENSTOCK AT USINE DE SOULOM, FRANCE

Length, L = 1759 ft. Internal Diameter, D = 32 in. (mean)
Static Head, H = 830 ft. a = 3580 ft. sec.

Time of Closing Gate in Sec. = T	Initial Velocity of Water in Sec.-ft. = V	Water-Hammer Observed, Ft. = h	Water-Hammer Calculated by Warren's Formula, Ft.	Water-Hammer Calculated by Michaud Formula, Ft.
5.00	9.30	156.0	111.1	203.0
3.37	6.22	170.0	118.0	202.0
2.50	4.50	187.0	122.0	195.0
2.00	3.60	208.0	130.0	197.0
1.46	2.67	215.0	150.0	202.0

Referring to the letter by Austin H. Reeves, it is difficult to see why he shirks the calculation of a, the velocity of vibration. This is given very simply by Allievi's formula $a = \frac{32{,}500}{\sqrt{48.3 + 0.5\frac{D}{e}}}$ in foot-pound-second units, where D = internal diameter in inches and e = thickness in inches, for steel penstocks.

Although this vibration velocity is not of any great importance in using Warren's formula, yet it is essential for the calculation of the highly important critical time, $2L/a$.

In conclusion, any of your readers who are interested in this subject would do well to study the work referred to above. The works of Allievi and De Sparre, although more theoretical, are also very valuable.

ERIC CREWDSON,
of Gilbert Gilkes & Company, Limited.
Kendal, Westmoreland, England.

[Proof of Mr. Crewdson's letter was submitted to Mr. Reeves, whose reply follows—EDITOR.]

Sir—The following points seem pertinent in discussing Mr. Crewdson's letter:

1. That since Mr. Crewdson says he has examined Mr. Warren's formula, it seems queer that he has, in order to obtain a "very simply", given Allievi's formula $a = \frac{32{,}500}{\sqrt{48.3 + 0.5\frac{D}{e}}}$, when Mr. Warren's formula $a = \frac{4660}{\sqrt{1 + 0.01\frac{D}{e}}}$ is more simple and gives the same result.

2. The present writer did not shirk the calculation of a.

3. The writer believes that "the highly important critical time, $2L/a$ would be more safely and economically expressed if a were taken as 2600 (that is, that the critical time might, for safety in penstock design, better be expressed $T = L/1300$), for the following reasons:

a. In order that the penstock may be designed safely, the factor of safety against water-hammer should be such as to limit the maximum fiber stress in the steel to less than the elastic limit of the steel, and, therefore,

b. Thin sections should, and usually do, determine the value of a, which in turn determines the critical T, even though the thicker sections experience the greatest shock; and furthermore

c. Because the thinner sections, due to joint efficiency and corrosive action, make a value for a of approximately 2600 seem desirable.

4. Therefore, I should have been more pleased if Mr. Crewdson, instead of saying, "it is difficult to see why he shirks the calculation of a, the velocity of vibration," had asked why I favored making the critical $T = L/1300$.

5. The designer (and he is the exception) who actually designs his penstock safely and economically against water-hammer from a manufacturer's T is the one who I think will agree with me that the critical time T should, from a scientific standpoint, be lengthened to equal approximately $L/1300$.

Charlotte, N. C. AUSTIN H. REEVES.

Some Reasons Why Standard Structural Specifications Are Necessary

Sir—In an editorial in your issue of July 3, 1919, p. 2, you say:

A railway engineer of unusually long experience says of standard design codes: "Standard specifications are a curse. They divest the individual engineer of responsibility and make him work to rule rather than to conscience."

. . . Unquestionably, a record of the conclusions and judgments developed by experience in bridge construction and maintenance, those conclusions which represent the sum of bridge knowledge, should be briefed in a document available for the general guidance of bridge engineers. But shall such a document take the form of a rigidly drawn set of rules, or shall it be modeled on another pattern? This is the essential problem presented.

It seems to me that a discussion of the standardizing of structural steel practice is in place at this time, when the American Railway Engineering Association is considering revision of its specifications. The writer's attitude, as expressed previously on more than one occasion, is that the more completely so-called common sense and professional judgment are eliminated, and structural designing reduced to rule, the better for the structures and the safety of the public. This is diametrically opposite to your editorial attitude.

In checking plans and examining structures during a period of more than a quarter century, I have many times found errors in design and details that could not possibly have been perpetrated by designers if they had observed certain rules of design, some of them of the simplest nature. Many times I have, in correspondence with designers, had the utmost difficulty in convincing them that their designs were faulty and actually dangerous—this because there was no rule published that covered the particular case in question.

Your railway engineer of long experience need not worry about the individual engineer's lack of opportunity to exercise his conscience. There is no better way to exercise the conscience than to work strictly in accordance with a set of good rules. Furthermore, there is nothing more at variance than the consciences of a lot of different individuals, whereas the laws of stability and equilibrium are as constant and invariable as the eternal hills and care as little for the passing opinions of professional men, no matter who they be.

Where would structural engineering be if it were divested of the rules of design that demand that unit stresses be so much for tension, so much for compression, so much for shear? Suppose every engineer should say that his conscience tells him that rivets are worth so much. All would be different; there would be confusion worse confounded. One man would use 10,000 lb. per square inch; another 25,000. If the second man's structure should fail, would it be because of the lack of a good, uniform standard of design or would it be because of his faulty conscience?

Some years ago some men high in the profession reached the conclusion that because of the magnitude of some very large bridges these structures could be safely designed with unit stresses far higher than the small fry had to use on their small-fry structures. It is hardly necessary to remind the profession that one of these large bridges fell, and another had to have the floor system revised to make its floor area approach more nearly to its carrying capacity.

A few months ago I had to condemn a large drawspan partly because the plane of the lateral system was 4 or 5 ft. out of that of the chords, and no provision had been made for the bending stresses produced. Some of the laterals had actually bent until they were useless. It would be the simplest kind of thing to require in specifications that where lateral systems are not in the plane of the chords, provision for the bending stresses must be made in the design. This is just the kind of thing that many designers cannot see. They say it is "their practice." If an ironclad rule were written into specifications, it might be "their practice" on something else, but they would learn that it is not good practice or safe design anywhere.

The simple little requirement that the distance center to center of trusses is the span length of floor-beams, and the distance center to center of floor-beams is the span length for stringers, has avoided countless disputes and has redeemed many a bridge from actual flimsiness. It is a fact that designers will, in spite of this, want to introduce their "conscience" and use a span less than these specified distances.

Lack of standard rules of design would introduce great unfairness in competitive designs. One designer would have a certain idea as to how the design of a certain structure should be made, whereas his competitor would have a conscience that is not so exacting. The latter would get along with much less steel—thin, unstiffened web plates, unbraced flanges, rod laterals instead of stiff members.

A specification writer who laid stress on professional judgment and whose work had some clauses not capable of definite interpretation, when asked personally by the writer the meaning of one of these clauses, stated that he would interpret it for a fee of $50. The clause could easily have been put in understandable English, and in such shape would be useful, for it would describe some definite kind of steel construction. All parts of specifications should be capable of only one interpretation, so that even here there is no room for judgment or so-called common sense. Ambiguity cannot help anyone, and it is apt to harm the structure.

I have just finished inspecting some very remarkable high viaducts, running to more than 200 ft. in height. The only kind of originality they show is strict adherence to the best rules of design and workmanship. Plans were checked, material was inspected as well as shop and field work. The steelwork was carefully painted with red-lead paint and has been repainted since. Conscience? Yes, every evidence of it, but conscience that has followed the rules of design and fabrication to the letter. The bridges are as good as the day they were finished. In contrast, the condemned drawspan to which reference has been made bears the stamp of a kind of professional judgment and common sense that evidently cared little for rules but thought that the structure designed was just the one for the case.

It is not meeting the needs of the case to embody (and embalm) these rules of design in a textbook or unauthoritative manual. They should be written in standard specifications where they are a law and not a mere opinion. Textbooks are frequently too theoretical and frequently unpractical in much that they say. There are textbooks that tell how to design a mill building, and there is perhaps not a mill building in existence that was designed that way. There is such a thing as being too strict and too theoretical, and there is also such a thing as being too lax and leaving too much to be taken for granted. The former breeds bad structures because the strict and theoretical rules are perforce ignored; the latter has the same effect because there are no rules to apply.

Pittsburgh, Penn. EDWARD GODFREY.

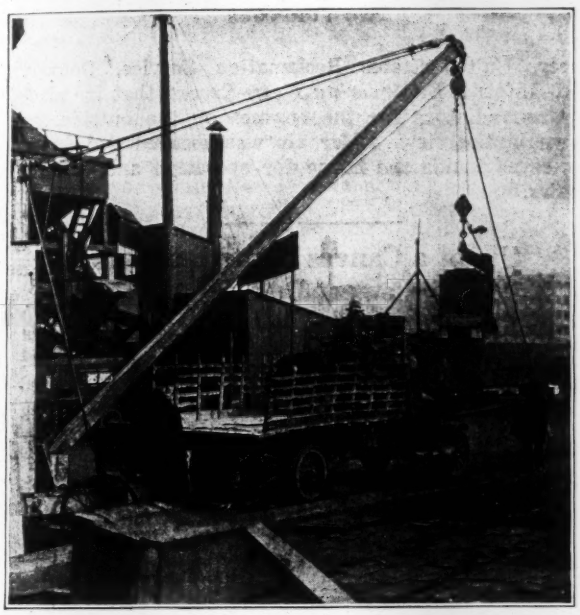
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Asphalt-Block Handling at Army Base

SPECIAL handling apparatus was used in transporting and delivering the asphalt block to the job at the South Brooklyn Army supply base. The blocks were specially piled at the manufacturing plant so that they could be readily picked up from the boat. There was thus only one piling operation from plant to pavement.

To accomplish this result, rectangular platforms were



LIFTING ASPHALT BLOCK (NOTE SPECIAL TONGS)

constructed upon which the blocks were piled. These may be seen in the view, under the packages being handled. The platforms were constructed in such a way that tongs could be slipped under them from a derrick, to keep them properly balanced. The derrick hooks are shown, lifting the platforms and loading them upon motor trucks for delivery at various parts of the job.

COWAN TRANSVEYORS PASSING UNDER PLATFORMS DELIVER BLOCK

Other Articles in This Issue of Interest to Contractors:

Largest Use of Electric Power on Construction Work — Page 417

Foundations in Quicksand and Watery Gravel — Page 414

Sunstroke and Lightning as Viewed by Compensation Commissions — Page 403

Those which were used upon the piers were lifted directly from the boat to the pier-floor level. By piling in this way, using a jib crane, 140,000 two-inch blocks could be loaded upon the average scow.

When the scows arrived at the Army base pier a similar pair of derrick tongs lifted the packages from the scow to the dock, where electric Cowan transveyors ran under the platforms, as shown, and delivered them to any part of the work. These transveyors ran in trains, so that one tractor hauled a trailer of the same type, with the exception that it had no motor. When the blocks reached their destination at the pavement side, the truck and trailer were automatically lowered, leaving the piles standing upon the platform. By this method, it was possible to get the blocks quickly to any part of the work with only one handling. This work was done by the Hastings Pavement Co., as stated on p. 402 of this issue, under the general contract by the Turner Construction Co., of New York, with the Construction Division of the Army, as noted.

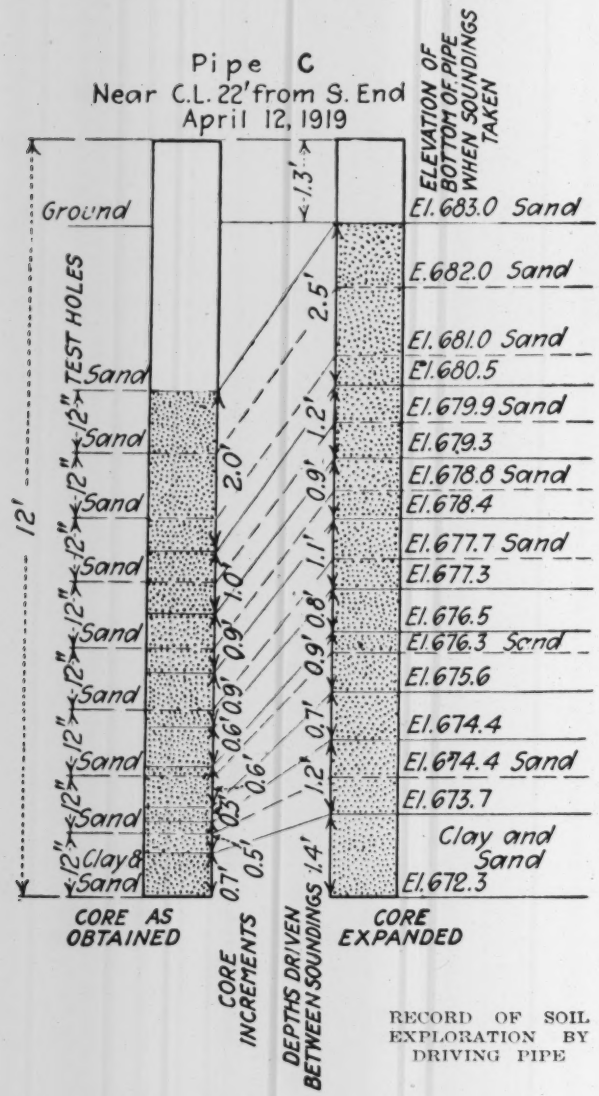
Soil Exploration by Pipe Sounding

BY R. C. CHANEY

Construction Engineer, River Channel Improvement, Columbus, Ohio

THE character of the soil below foundations to be built was determined in a satisfactory manner by means of an arrangement devised by the writer, on the Columbus flood protection work now under way. A 6-in. wrought-iron pipe 15 ft. long was driven as a pile in swinging leads at selected locations in the unwatered cofferdams for the piers and abutments of the Town St. arch bridge of reinforced concrete.

At intervals of 1 ft. in the length of the pipe, 1-in. holes were drilled for sampling the core obtained. For the purpose of determining the core increments, the pipe



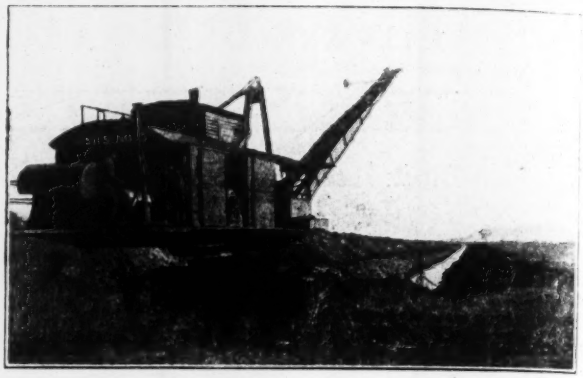
RECORD OF SOIL EXPLORATION BY DRIVING PIPE

is sounded at every foot of penetration. The pipe is driven to depth and pulled, and the core is sampled.

Then, as shown in the drawing, the log of the soundings and samples allows the expansion of the core to its original height, and a section is obtained showing very definitely the character of soil within the limit of depth practicable for the device, which limit is imposed by the difficulty of pulling. The pipe is particularly useful here, where the material encountered is a tough blue clay, with strata of gravel and sand. In one case a pocket of quicksand was sounded by this means and the bottom found to be blue clay. Greater depth of determination may be reached by the development of a head for the pipe that would withstand greater pulling strains.

Radiators Outside on Oil-Driven Draglines Secure Cooler Air, Save Space

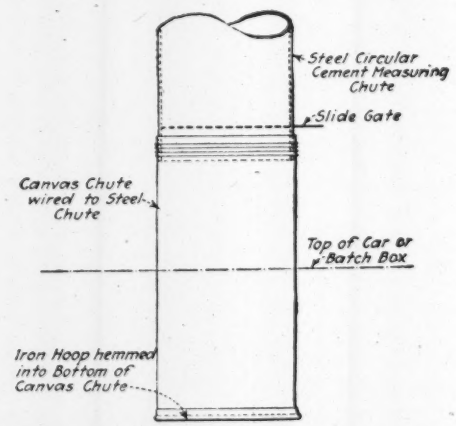
ON THE extensive drainage work now being done on the Rio Grande irrigation project of the United States Reclamation Service, a number of dragline excavators are being used. J. L. Burkholder, drainage engineer, United States Reclamation Service, Denver, Colo., informs *Engineering News-Record* that by placing the radiators for the engines on the outside, as shown in the view, cooler air was secured and space was saved inside the house for operation and making repairs.



RADIATOR ON OUTSIDE OF EXCAVATOR SERVES TWO PURPOSES

Use of a Canvas Chute Prevents Cement Dusting

THE dust cloud which results when cement is dropped into a car or batch-box from the vertical measuring chute of a bulk-cement bin can be prevented by wiring a hoop-weighted canvas chute to the bottom of the steel chute. This device has been successfully employed by G. P. Scharl, contractor, Milwaukee, Wis., on a concrete paving job on which bulk cement is being used.


Steel Circular Cement Measuring Chute
Slide Gate
Canvas Chute wired to Steel Chute
Top of Car or Batch Box
Iron Hoop hemmed into Bottom of Canvas Chute

CANVAS EXTENSION PREVENTS DUST CLOUD ARISING FROM CEMENT

A 12-in. circular measuring chute is employed. When cement is charged into a batch-box, the canvas extension is swung into the box, where the iron hoop holds it down, and then the gate is opened. When the charge has entered the canvas chute it is lifted, allowing the cement to run out gently and with no drop. It is then swung into the next batch-box.

The cement chute when not in use can be swung to one side to be out of the way of the work, and fastened in place.

NEWS OF THE WEEK

New York, August 28, 1919

Sanitary Engineers Recently in Service Need Positions

A considerable number of sanitary engineers who were in Army service during and after the war are in need of positions and assert that they are quite out of touch with opportunities for work, *Engineering News-Record* is credibly informed. These men include some who have recently received their discharge and others are likely to be discharged soon. Altogether there were about 180 men in the sanitary engineering section of the Office of the Surgeon General, and it is estimated that 75% of these are technically trained sanitary engineers. Information regarding the men wishing positions and their qualifications may be obtained by addressing the Sanitary Engineering Section, Office of the Surgeon General, United States Army, Washington, D. C.

First Government Concrete Ship Is Commissioned

On Aug. 16 the concrete steamship "Atlantus" was turned over by the United States Shipping Board to the Raporel Steamship Line, of New York, for operation in the West Indian service of the company. This is the first of the Government concrete ships to be put into service. The "Atlantus" is a 3500-ton freighter, built at Wilmington, N. C.

St. Louis Municipal Bridge Subject to Illinois Taxation

Suit brought by St. Clair County, Illinois, to compel payment of taxes by the City of St. Louis, Mo., on the easterly half of the municipal bridge across the Mississippi River, has been decided in favor of the Illinois contention. The county court held that taxation is proper because the bridge is intended to produce revenue by the lease of its railway deck. The east or Illinois half of the bridge has been valued at $600,000 by the assessors, and the 1918 taxes on this amount, which were in suit, are about $17,000. The bridge with its present approaches cost over $6,000,000.

T. H. Wiggin to Design Grand Canal Improvement in China

Thomas H. Wiggin has resigned his position as designing engineer with the Board of Water-Supply of the City of New York, and is now on his way to China, where he will remain about six months on the work of the preliminary designs for improving the Grand Canal. Joseph Ripley is chief engineer in charge of surveys and studies for this work and John R. Freeman is consulting engineer.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

Mr. Wiggin recently returned from two years of active service with the A. E. F. in France, where he was on the staff of the Chief Engineer, Line of Communication (afterward known as Director of Construction and Forestry), and had charge of the section of water-supply and sewerage. He entered the army from the Engineer Officers' Reserve Corps, in which he was captain, and received successive promotions to major and lieutenant colonel.

As officer in charge of the water-supply section of the Division of Construction and Forestry of the A. E. F., Lieutenant Colonel Wiggin had general supervision over all of the water-supply projects in the zone of the Services of Supply. Among the works constructed were a curved concrete dam at Savenay, and important additions to the water-supply systems at Brest and St. Nazaire, the main embarkation centers for the American Army in France. Water-supplies also were installed at all of the big hospital centers, and some of them, such as those at Mars and Mesves, with 20,000-bed capacities, represented full-sized cities.

In recognition of his work as officer in charge of the water-supply section, Lieutenant Colonel Wiggin last April received from the Commander-in-Chief, A. E. F., a citation for "exceptionally meritorious and conspicuous services."

Townsend Bill and State-Aid Law Not in Conflict

That the passage of the so-called Townsend national highway bill will have no detrimental effect upon Federal state-aid work is the opinion of Senator Townsend, as expressed in the following letter sent Aug. 11 to S. M. Williams, chairman of the Federal Highway Council:

"Replying to your inquiry concerning my views as to the effect of the passage of the so-called Townsend national highway bill upon the present or future of the Federal state-aid law, now in existence, I hasten to say that such effect cannot be by any possibility detrimental to the state. The object of the bill introduced by me is to establish and maintain a national system of highways, according to a national plan, connecting the different states of the Union, and affording an example of proper highway construction, which will be beneficial to the states. The bill does not in any manner injuriously affect existing law; in fact, it provides that the commission created under it shall have charge of the Federal-aid law, and shall make reports annually to the Congress as to what is being accomplished under existing law, and make such recommendations for the future as the operation of the law and its results seem to make necessary. The two systems of road building are separate and distinct, except that they are under control of the same Federal commission. The appropriations, however, cannot be mingled, and the results will be known and properly appraised by the people from time to time. If the present Federal-aid law proves satisfactory, it will, as a matter of course, be continued, and probably enlarged; if the proven results are not satisfactory, that law will be discontinued. And what I say of the Federal-aid law will be true of the bill now pending before the Senate.

"The commission appointed under the law, it may safely be presumed, will be high-grade men, representing different sections of the country, and their lifework will be to serve the people by furnishing the best possible highway transportation facilities."

Illinois Surveyors' License Law

An act passed by the Illinois legislature requires those who practice land surveying after Jan. 1, 1920, to have a certificate of registration issued by a county board consisting of the recorder and two land surveyors appointed by the county judge. Applicants for registration must be 21 years of age, with four years of experience and training, and must pass an examination

in surveying. Certificates must be renewed annually. The examining board is appointed by the Governor, who has named W. D. Jones, of Chicago, as secretary and treasurer. This law applies to counties having a population of 250,000 and over. It exempts county surveyors and employees of city, county and state governments, as well as those of the Federal Government.

New Engineering Society List

Engineering News-Record has prepared a new 1919 list of technical societies and national engineering trade associations of the United States and Canada. The list is in booklet form, 4¼ x 6¾ in., 22 pages. The present list is a revision of the one prepared in 1917, and contains many additions.

The societies have been divided into national, state and district, and local organizations. The information consists of the office addresses of these societies; the name of the president and the secretary; the address of the secretary; the number of members and the usual months of the annual meetings.

A limited number of copies of the booklet are available to those who would find them useful, such as the officers of engineering societies and others who may be interested. They may be obtained by application to *Engineering News-Record*, Editorial Department, 10th Ave. at 36th St., New York City.

Army Surplus Materials for Sale

Various materials and equipment used by engineers and contractors, such as caterpillar tractors, escort wagons, metallic measuring tapes and spades, are included in current announcements of surplus materials offered for sale by the War Department.

Fourteen Gray, wide-drive, drum tractors of the commercial type used for road-building and agricultural projects, of 18-36 hp., are for sale at $1640 each, f.o.b. warehouse, Gray plant, Minneapolis.

Two hundred and fifty escort wagons at Jeffersonville, Ind., will be sold to the highest bidder Sept. 10, when bids will be opened by the Surplus Property Officer, Zone Supply Office, at Jeffersonville.

Some 4000 or 5000 metallic and steel measuring tapes stored in Chicago will be sold to the highest bidder Sept. 15. Bids will be opened by the Surplus Property Officer, Zone Supply Office, 1819 W. 39th St., Chicago. There are over 1400 steel tapes of 100-ft. length.

About 38,000 new steel spades, in New York, will be sold to the highest bidder Sept. 10, when bids will be opened by the Surplus Property Officer, Zone Supply Office, 461 Eighth Ave., New York City.

Inquiries for further information should be directed to the Ordnance Salvage Board, Ordnance Department, 6th and B Sts., S.W., Washington, D. C., or to district offices in the large cities.

Agree on Principle of Self-Supporting Roads

House Committee Witnesses Opposed to Railroad Plans Necessitating Government Guarantees

Virtual agreement on the principle of establishing railroad rates to make the carriers self-supporting, and opposition to any plan which would virtually call for Government guarantees and the making up of operating deficits out of the national treasury, marked the testimony of some of the chief witnesses before the Interstate Commerce Committee of the House of Representatives in Washington in the past week. The witnesses included George A. Post, chairman of the railroad committee of the Chamber of Commerce of the United States, Howard Elliott, R. S. Lovett, and Alba B. Johnson, formerly president of the Baldwin Locomotive Works.

Mr. Post presented the plan adopted by letter ballot of the Chamber of Commerce, which was outlined in *Engineering News-Record* of June 26, 1919, p. 1281. The plan is flatly opposed to Government ownership and provides for the establishment of rates which will make the railroads self-supporting.

While no definite plan was presented in detail by Mr. Elliott, he urged the principle of adjusting rates so that the roads shall be self-supporting rather than adopting the policy of continuing appropriations from the Treasury. Mr. Elliott also testified that ownership by individuals "with wise, energetic and honest management and operation under suitable, thorough and protective regulation" would produce the best results for the country. He emphasized the necessity of establishing a "self-supporting" level of rates in order to attract sufficient capital for necessary expansion of transportation facilities.

Judge Lovett emphasized the statement that the railroad situation as it now exists is merely a question of credit. He pointed out that the Government does not propose to guarantee dividends and that the investor must depend upon net earnings under the regulations which Congress will prescribe. The investor must decide whether he will risk his money in railroads or put it in some other business. He joined the other witnesses in urging the establishment of a principle of self-supporting rates, but pointed out that revision would have to be made in the accounting rules of the Interstate Commerce Commission before this could be done, since "the amount chargeable to maintenance and repairs, under the Interstate Commerce Commission's regulations, is not sufficient to make the renewals and repairs necessary to maintain the railroad property."

The most radical feature of Mr. Johnson's testimony was the recommendation for establishing a Federal Transportation Board to determine the amount of revenue "necessary to the public interest" to be earned by the railways. This plan provides for the continuance of the Interstate Commerce Commission as a court to insure that "in getting things done, the men of action [the Federal Transportation Board] shall not ride roughshod over the citizens and communities who use the facilities."

Council Urges Engineer for Interstate Commerce Commission

Engineering Council, through its chairman, J. Parke Channing, has addressed a letter to President Wilson urging the appointment of an engineer to fill the existing vacancy on the Interstate Commerce Commission. It is pointed out that the transportation systems of the country are largely the creation of engineers, and that the genius and knowledge of the engineer are essential to the successful operation and maintenance of the properties. Mr. Channing's letter requests the appointment of a man who adds to his other qualifications the training and experience of an engineer in transportation problems.

San Francisco Wins Lawsuit to Protect Water Rights

The so-called Poopenaut Valley condemnation suit, whereby the City of San Francisco has sought to establish the right to condemn land in the Poopenaut Valley, four miles below the Hetch Hetchy dam site, has been decided by Judge C. W. Nicol, of Tuolumne County, in favor of the city. The suit was brought to determine whether the lands in Poopenaut Valley owned by the Yosemite Power Co. could be acquired by the city to provide for possible future additions to its mountain reservoir system.

National Society May Regulate British Engineering Practice

In England an effort is being made to regulate the practice of engineering through the agency of the Institution of Civil Engineers. If the campaign is successful that body will receive statutory powers whereby its decision will be the one by which candidates for admission to the profession will be admitted or rejected. To discover the attitude of the membership toward this subject the following letter ballot was recently sent out by the secretary:

I, ———, approve of the Institution of Civil Engineers taking steps to obtain statutory powers to prescribe the qualifications and to conduct examinations for admission to the profession of civil engineering, to keep a register of civil engineers, and to prevent persons who are not duly qualified from holding themselves out as members of that profession.

Investigating Grain Elevator Accident

The Hon. J. D. Reid, minister of railways and canals, Canadian Government, has appointed a board of engineers to ascertain the cause of the recent Government grain-elevator explosion at Port Colborne. On the board are Col. C. N. Monsarrat, consulting engineer for the Government; A. St.

Laurent, assistant deputy minister of public works; D. A. McLachlan, engineer in charge of the Port Nelson terminals of the Hudson Bay R.R.; and John Murphy, electrical engineer of the Department of Railways and Canals.

Theodore Cooper Dies in Eighty-First Year

Theodore Cooper, for thirty years one of New York's best known consulting engineers, an authority on bridge design and construction, and former instructor in the United States Naval Academy, died Aug. 24 at his home, 353 W. 57th St., New York City. He was 80 years of age, and unmarried.

Mr. Cooper was born at Cooper Plains, N. Y., Jan. 12, 1839, and was graduated from the Rensselaer Polytechnic Institute in 1858. His first work of engineering responsibility was done in connection with the construction of the Hoosac tunnel on the Troy & Greenfield R.R., in 1861.

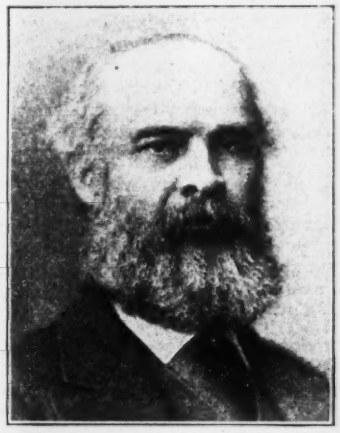
At the outbreak of the Civil War, Mr. Cooper entered the United States Navy as third assistant engineer. His service with the Navy lasted until 1872, part of which time he served as instructor in engineering and chemistry at the Naval Academy. At the time of his resignation from the Navy he held the rank of first assistant engineer.

Mr. Cooper then became resident engineer on the construction of the St. Louis bridge. Later he was superintendent of the Delaware Bridge Co.'s shops at Phillipsburg, N. J. Still later he became assistant general manager and superintendent of the Keystone Bridge Co., of Pittsburgh.

Establishing himself as consulting engineer in 1879, Mr. Cooper designed the Seekonk bridge at Providence, R. I.; the Sixth Street bridge at Pittsburgh; the Second Avenue bridge over the Harlem River, New York City; the Newburyport bridge over the Merrimac, and the Junction bridges over the Allegheny. He also designed and superintended the construction of the Laredo shops of the Mexican National R.R. He was appointed by President Cleveland a member of a board of five engineers to determine the Hudson River bridge span in 1894. Other consulting work included the New York Public Library and the Quebec bridge, and work for the Suburban Rapid Transit Co., the New York Rapid Transit Commission, the Boston Rapid Transit Commission and the Harlem River Commission. He retired from active practice in 1907. Besides being a member of the American Society of Civil Engineers, to which society he was admitted in 1874 and which he served as director in 1884 and 1885, Mr. Cooper held membership in the Military Order of the Loyal Legion, the New York Chamber of Commerce, the New York Historical Society and the Century Association. He was also a life member of the Naval Institute and the Society of Fine Arts, and a corresponding member of the Institute of Architects.

Mr. Cooper was a frequent contributor of technical papers at sessions of the American Society of Civil Engineers, and on two occasions he received the Norman medal from that society, his papers, "The Use of Steel For Bridges," contributed in 1880, and "American Railroad Bridges," being so distinguished.

Famous Bridge Engineer



THEODORE COOPER

An important contribution of Mr. Cooper to railroad bridge construction was his "General Specifications for Iron Railroad Bridges and Viaducts," published in 1884, forming the first authoritative specifications on bridge construction that had been published and circulated. Those first specifications were revised from time to time and republished, along with specifications for highway bridges and for foundations and substructures of highway bridges and electric-railway bridges. The seventh edition of his steel railroad bridge specifications was issued in 1906.

Even more than through his specifications, however, Mr. Cooper's name became universally familiar to bridge engineers through his system of locomotive and train loading for bridge design. Composed of a wheel system representing the heaviest locomotives of that time, followed by a uniform load whose amount in pounds per foot bore a simple relation to the driving-axle load, this system proved so convenient, and was excellently adapted to modification for increasing weight of trains and engines by simple multiplication, that it quickly won a commanding position, and for many years now has been the almost universal standard for railway-bridge design in America. Theodore Cooper also exerted a strong influence toward bringing about the adoption of wheel-load analysis for railway bridges in place of uniform-load or other methods, and the moment tables which he published made it possible to carry out the analysis rapidly and conveniently.

Graphically Shows Effect of Production on Living Cost

Under the caption, "Let's Go," the Chicago *Herald and Examiner* published the following editorial Aug. 22:

"Put one hundred men on an island where fish is the staple article of sustenance. Twenty-five of the men catch fish. Twenty-five others clean the fish. Twenty-five cook the fish. Twenty-five hunt fruit and vegetables. The entire company eats what thus is gathered and prepared.

"So long as everybody works there is plenty. All hands are happy.

"Ten of the allotted fish catchers stop catching fish.

"Ten more dry and hide part of the fish they catch.

"Five continue to catch fish, but work only part of the day at it.

"Fewer fish go into the community kitchen.

"But the same number of men insist upon having the same amount of fish to eat as they had before.

"The fifty men who formerly cleaned and cooked the fish have less to do owing to the undersupply of fish. But they continue to demand food.

"Gradually greater burdens are laid upon the fruit and vegetable hunters. These insist upon a larger share of fish in return for their larger effort in gathering fruit and vegetables. It is denied them and soon twenty of the twenty-five quit gathering fruit and vegetables.

"But the entire one hundred men continue to insist upon their right to eat.

"The daily food supply gradually shrinks. The man with two fish demands three bananas in exchange for one of them. The man with two bananas refuses to part with one for fewer than three fish.

"Finally, the ten men remaining at work quit in disgust. Everybody continues to eat. The hidden fish are brought to light and consumed. Comes a day when there is no food of any kind. Everybody on the island blames somebody else.

"What would seem to be the solution?

"Exactly! We thought you would guess it.

"For we repeat that you can't eat, buy, sell, steal, give away, hoard, wear, use, play with or gamble with WHAT ISN'T."

Salt Lake and Denver Railway Project Is Revived

A company organized and headed by Governor Bamberger of Utah proposes to build a railway east from Provo into the Uintah basin, to provide for the development of coal, oil, timber and other resources of the district, and the project includes the extension of the road to Craig, Colo., the present western terminal of the Denver & Salt Lake R.R., known as the Moffat line. The total length would be about 310 miles,

giving a 600-mile direct route between Denver and Salt Lake City. It is intended to limit the grades to 2% and the curves to 10°, thus giving the Uintah basin a favorable outlet westward.

Government Receiving Bids for Sale of City of Nitro

The War Department is offering for sale the town of Nitro, W. Va., a complete industrial community embracing 737 manufacturing buildings, and housing accommodations for 20,000 persons, including utilities and civic improvements. The town was built by the Government at a cost of approximately $70,000,000, and is the site of the second largest smokeless-powder plant in the world.

Bids must cover not only the powder plant and other industrial units, but also the buildings comprising the community. Bids will be opened at 12 o'clock noon, Sept. 30, 1919, at the office of the Chairman of the Ordnance District Salvage Board, 1710 Market St., Philadelphia, Penn.

Civil Service Examinations

New York State. Bridge designer, office of Transit Construction Commissioner, $1500 to $2100, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior assistant engineer, State Engineer and Highway Department, $1200 to $1440, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior engineer, Transit Construction Commission, New York City, $1200 to $1500, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Sanitary engineering inspector, State Department of Health, $1320, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Research engineer, $2,800 to $3,200 per year, Ordnance Department. File application before Sept. 2.

Research physicist, $2,700 to $3,200 per year, Ordnance Department. File application before Sept. 2.

Mathematics and dynamics experts, Grade I, $2,500 to $4,000 per year; Grade II, $4,000 to $5,000 per year, Ordnance Department. File application before Sept. 2.

Specification engineer, Office of Chief Signal Officer, War Department, Washington, D. C., $2000 to $2400 per year, Sept. 9. File applications before Sept. 9.

Chief metallurgist, $4,500 to $5,000 per year; assistant chief metallurgist, $3,600 to $4,500 per year, Ordnance Department. Applications must be filed before Sept. 16.

Computer, Ordnance, Navy Yard, Washington, D. C., $7.20 to $12 per diem, Sept. 17. File applications in time to arrange for examination at place selected by applicant.

Junior highway bridge engineer, Office of Public Roads and Rural Engineering, Department of Agriculture, $1200 to $1600 per year, Sept. 17. File applications with commission at Washington in time to arrange for examination at place selected by applicant.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION Tremont Temple, Boston, Sept. 30, Oct. 1-3, Albany, N. Y.

AMERICAN SOCIETY OF NAVAL ENGINEERS; Secretary, Lieut. Com. F. W. Sterling, U. S. N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMEPICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, 304 E. Walnut St., Bloomington, Ill.; Nov. 11-14, New Orleans.

The Washington State Good Roads Association will hold its 20th annual convention at Yakima, Wash., Sept. 1-2. At a recent meeting of the executive committee a resolution was passed favoring the cutting up of road contracts into several smaller jobs, so that the small contractor could bid more easily. It will be urged at the convention that the Federal Government construct the proposed military highway from the Mexican border to British Columbia.

The Duluth Engineers' Club discussed the national water-power bill at its monthly meeting Aug. 19. A report on the bill prepared by a committee was read by Howard J. Underhill; indorsement by the club was recommended. The conclusions of the report were generally indorsed, but it was referred back for minor amendments. Protection of the dye industry was unanimously indorsed by vote of the club.

The Salt Lake Chapter of the American Association of Engineers was installed Aug. 16. Dr. F. H. Newell, president of the association, addressed the chapter.

The Los Angeles Chapter of the **American Association of Engineers** is endeavoring to affiliate with itself the Engineers and Architects' Association of Southern California.

The Tidewater Virginia Chapter of the American Association of Engineers, at a recent meeting, charged Norfolk, Va., dealers with profiteering. One member asserted he bought lumber outside the state, paid transportation costs, and then was $5 under prices given by a Norfolk dealer.

The Colorado Society of Engineers held a special meeting Aug. 12. A dinner was given to Dr. F. H. Newell, who delivered an address on the desirability of affiliation with the American Association of Engineers. The membership is being canvassed concerning the opinion on such affiliation.

The Utah Society of Engineers, at a special meeting in Salt Lake, Aug. 13, was addressed by Philip N. Moore, past president of the American Institute of Mining Engineers, on the proposed National Department of Public Works. W. W. DeBerard, Western editor of *Engineering News-Record*, spoke on "Professional Engineering Publicity Problems Analyzed." The meeting was held in conjunction with the local sections of the A. I. M. E., the A. I. E. E., the Am. Soc. C. E., and the American Mining Congress.

The Oregon Society of Engineers has been installed as a chapter of the American Association of Engineers. The installation was directed by Dr. F. H. Newell, president of the association.

The Omaha Chapter of the American Association of Engineers, at its meeting Aug. 12, organized a committee, headed by J. A. Bond, city engineer of Omaha, to study paving so that its investigations and recommendations may be sent to the county commissioners of Douglas County. The county recently voted a $3,000,000 bond issue for good roads.

The Pennsylvania Railroad Section of the American Association of Engineers is seeking the coöperation of all engineering organizations in Pennsylvania to obtain the appointment of two engineers to fill vacancies on a commission created by the last session of the legislature to supervise the construction of a bridge across the Delaware River at Philadelphia.

PERSONAL NOTES

CHARLES E. GREGORY, formerly engineer of drainage and sewage disposal, Borough of Manhattan, New York City, has resigned, to become deputy engineer of the North Jersey District Water-Supply Commission.

WILLIAM L. HANAVAN has resigned from the engineering staff of the New York Public Service Commission and has become associated with the Vulcanite Portland Cement Co. Prior to his connection with New York subway construction he was for a number of years on the Catskill Aqueduct work.

J. O. GREENWAY has resigned as drainage engineer for Yakima County, Washington, to become engineer for the Washington Brick, Lime & Sewer-Pipe Co., Spokane, Wash.

HARVEY A. ANDERSON, assistant engineer physicist, United States Bureau of Standards, has resigned, to become aëronautical engineer in charge of the physical testing section, research division, of the naval aircraft factory in Philadelphia. Mr. Anderson is the author of the Bureau of Standards' publication on "Mechanical Properties of Materials."

GILBERT K. COOPER and GEORGE B. MCCLARY, Chicago, have formed the partnership of COOPER & MCCLARY, civil engineers. Mr. McClary was recently discharged from the Army, having served as a captain of engineers in France.

ROBERT THOM, formerly county surveyor of Tuolumne County, California, has become county engineer. The office of county surveyor has been abolished, as noted in *Engineering News-Record* of July 24, 1919, p. 197.

PAUL D. PRATT, chief engineer of the Montana State Highway Commission, has resigned, to become associated with the State Highway Construction Co., Helena.

EDWARD N. LAKE, formerly manager and treasurer of the Krehbiel Co., electrical and mechanical engineers, Chicago, is now president of the LAKE ENGINEERING CO., City Hall Square Bldg., Chicago. Previously he was resident engineer for the STONE & WEBSTER COMPANY.

ROBERT B. WARNER and W. R. CASEY have opened offices in Springfield, Mass., under the firm name of WARNER & CASEY, architects and engineers.

CHARLES W. MCKAY has taken charge of the appraisal division of L. V. Estes, Inc., Chicago.

W. H. TIMBIE, for the past year engaged in educational work with the War Department, and prior to that time instructor in applied science at both Wentworth and Pratt Institutes, has been appointed associate professor of electrical engineering in the Massachusetts Institute of Technology. Mr. Timbie is the author of books relating to electrical engineering.

CAPT W. E. DARROW, 33rd Engineers, U. S. A., has received his discharge from the service and has returned to his position as assistant engineer, New York State Highway Department, with headquarters at Utica.

HENRY N. FREES, former superintendent on various United States Steel Corporation's housing projects, has become a vice-president of the W. J. Parsons Housing Co., Chicago.

LEONARD MACBEAN, contractor and engineer, has transferred his main office to New York City, at 30 E. 42nd St. M. W. PLUMB, who has been with the United States Shipping Board as traffic engineer of the second district, is associated with Mr. MacBean.

J. L. LYTLE, district engineer, United States Reclamation Service, Provo, Utah, and G. F. MCGONAGLE, state engineer of Utah, have been appointed advisory engineers in charge of collecting data for the storage of flood waters of the Jordan and Weber Rivers. A. F. PARKER, consulting engineer, Ogden, Utah, will have active charge of the work. A fund of $10,000 has been subscribed in eight counties where the reclamation of 100,000 to 200,000 acres might be effected.

J. L. MCCONNELL has resigned his position with the American International Shipbuilding Corporation and has opened an office at 105 W. Monroe St., Chicago, making a specialty of the design of industrial plants. Previous to the war he was engineer for Holabird & Roche, architects, of Chicago.

JOHN N. EDY, heretofore assistant chief engineer of the Montana State Highway Commission, has been appointed chief engineer of the commission, the appointment to be effective Sept. 1, 1919. He succeeds PAUL D. PRATT, whose resignation is noted elsewhere in these columns.

JAMES L. BRUFF, who, for 12 years prior to 1917 was connected with the TURNER CONSTRUCTION CO., and since that time has been vice-president of the JOHN W. COWPER CO., INC., engineers and contractors, Buffalo, N. Y. has resigned his position to take charge of the contract department of THOMPSON & BINGER, INC., at their Syracuse office.

FRANCIS B. SMITH, engineer for the San Francisco Bridge Co., is returning to San Francisco after about 10 years in Hawaii, where he was in charge of construction of the Government dry dock recently completed at Pearl Harbor.

SYLVESTER Q. CANNON, city engineer of Salt Lake City, Utah, has been relieved of the duties of superintendent of the Water Department, which duties he assumed, as a measure of economy, during the war. H. K. BURTON, water-supply engineer in Mr. Cannon's office, has been appointed to the position.

LE GRAND BROWN, formerly an engineer in Rochester, N. Y., who has been engaged in consulting work in California for a number of years, has been appointed deputy city engineer of Rochester.

S. B. ROBERTSON, successively division engineer of the Pennsylvania Lines West, superintendent of the Erie and Ashtabula division, superintendent of the Cleveland and Pittsburgh division, and general superintendent of the Lines West, has resigned to become associated with the B. F. Goodrich Rubber Co., Akron, Ohio.

JOSEPH A. MURRAY, JR., has resigned as lieutenant, junior grade, U. S. N., and has returned to the Bureau of Engineering, Albany, N. Y., where he has been appointed engineer in charge of the sewage-disposal system.

CAPT. GERMAIN P. GRAHAM, 20th Engineers, U. S. A., has been discharged from the service and has resumed his work as assistant engineer in charge of construction, Bureau of Engineering, Albany, N. Y.

H. E. BILGER has resigned as road engineer with the Illinois Highway Department, and has become consulting engineer for the Monmouth Stone Co., Monmouth, Ill. Mr. Bilger has been with the highway department for 12 years.

E. V. CAMP, consulting engineer, Atlanta, Ga., has been employed by the county commissioners to supervise engineering work in connection with road building in Murray County.

CHARLES W. ATTWOOD and ERNEST H. TRYSELL, Detroit, Mich., have announced a partnership under the firm name of ATTWOOD & TRYSELL, architects and engineers.

CAPT. A. STEARNS WILSON, Engineers, U. S. A., has been discharged from the service and has reopened consulting and contracting offices at 51 E. 42nd St., New York City.

H. S. MATTIMORE, for 15 years connected with the New York State Highway Commission, nine years being spent in charge of physical testing work, has resigned and has accepted a similar position with the Pennsylvania State Highway Commission.

J. C. MCCULLOUGH, superintendent of the Panhandle Line, Pennsylvania R.R., succeeds S. B. ROBERTSON as general superintendent of the Pennsylvania Lines West. The resignation of Mr. Robertson is noted elsewhere in these columns.

A. E. CHANDLER has resigned from the California Water Commission, whose work he has been directing for several years. Mr. Chandler will take charge of the water department in a firm of San Francisco attorneys, the new name of which will be Haven, Athearn, Hall & Chandler.

OBITUARY

THOMAS COLE, for 33 years secretary of the Institution of Municipal and County Engineers, with headquarters in London, died Aug. 3, aged 73 years. For the past five years he had been the institution's honorary secretary. Mr. Cole was associated with various engineers in London engaged in railway and other work, until he opened an office for practice as a consulting engineer.

MAJOR GEORGE SYKES, Engineers, U. S. A., who recently returned from service overseas, died Aug. 21 at Flushing, N. Y., aged 38. Prior to entering the Army in 1917 Major Sykes practiced engineering and building construction in New York City.

THOMAS KING, for many years a Brooklyn, N. Y., contractor and builder, died at his home there Aug. 19, aged 74 years.

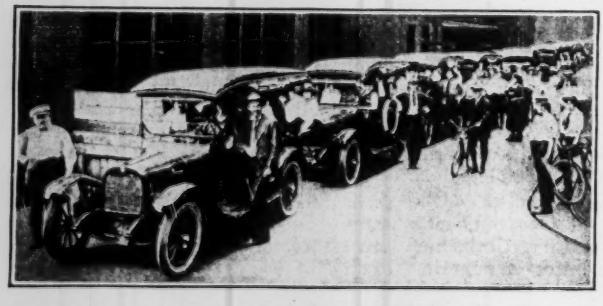
WILLIAM P. CUNNINGHAM, commonly known among engineers and contractors in the East as "Bill" Cunningham, regional manager of the Allied Machinery Co. of America, and formerly with the Lakewood Engineering Co., died at his home in Glen Ridge, N. J., Aug. 14, following an acute attack of appendicitis and an operation therefor.

Light, Fast Business Cars Solve Street-Car Strike Problem

A wide range of usefulness of the light type of commercial motor car was demonstrated recently during the street-car strike in Detroit. Cars were tied up nearly a week, and although thousands of employees lived several miles from the factory of Dodge Bros., the factory continued in operation throughout the strike period. This was made possible by a thorough system of transportation in which screen-side business cars by the hundreds were employed.

The cars were routed at regular intervals over all sections of the city, picking up employees at appointed places and hurrying them to their work. In the evenings the same cars lined up in imposing fleets at the factory gates, as shown in the accompanying illustration, and carried the employees home.

Officials of the plant found that there was actually less tardiness during the strike than there is ordinarily, when employees depend on street cars for their transportation. The screen-side business car is as speedy as the average passenger car and is designed for half-ton capacity.



BUSINESS CARS USED FOR EMPLOYEES DURING STREET-CAR STRIKE

BUSINESS NOTES

THE JEFFREY MANUFACTURING CO., Columbus, Ohio, has opened an office in the Book Bldg., Detroit, in charge of O. B. Wescott.

THE CHICAGO PNEUMATIC TOOL CO. has moved its Cincinnati office from the Mercantile Bldg. to the Walsh Building.

THE READING ENGINEERING CO., INC., 154 Nassau St., New York City, has been formed by James P. Reading, formerly of the Hubbard-Floyd Co., New York City, to carry on a general equipment business.

THE FISHER GOVERNOR CO., Marshalltown, Iowa, has opened an office in New York City at 1 Franklin St.; it will be in charge of P. L. Rhodes.

THE MERRILL-STEVENS SHIPBUILDING CORPORATION, Jacksonville, Fla., and the LOUISIANA SHIPBUILDING CORPORATION, Slidell, La., have established an office in New York City at 280 Broadway, in charge of Orlando H. Taylor as New York representative of the two companies, and W. W. Helvenston as purchasing agent of the Merrill-Stevens corporation.

THE WESTINGHOUSE AIR BRAKE HOME BUILDING CO. has recently been organized with a capital of $1,000,000. The chief function of the new company will be the transaction of all business relative to the real estate and dwellings which have been transferred by deed to the new company by the Westinghouse Air Brake Company.

THE UNIVERSAL PORTLAND CEMENT CO., Chicago, has combined the promotion and inspection bureaus under the name of "Service Bureau." J. H. Libberton, formerly engineer, promotion bureau, and inspecting engineer, in the general offices of the company in Chicago, has been appointed manager of the Service Bureau; G. E. Warren, assistant manager; J. W. Lowell, Eastern manager, Pittsburgh; J. H. Chubb, Northwestern manager, Minneapolis; and O. L. Moore, chief cement inspector, Chicago.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE CHICAGO PNEUMATIC TOOL CO., Chicago; leaflet announcing "Boyergrip," designed to fit over muzzle of pneumatic riveter, to provide full control of hammer without the grasping of the heated cylinder.

THE TROY WAGON WORKS CO., Troy, Ohio; booklet, 8 x 8 in., 22 pages; explains how to figure what a motor truck can do, and gives tables of comparative cost data, and charts to figure road resistance; also, catalog, 8 x 9 in., 23 pages, illustrated; shows details of slow-speed trailers for use behind slow-speed tractors.

THE EARLE GEAR & MACHINE CO., Wayne Junction, Philadelphia, Penn., catalog, 9½ x 6¼ in., 18 pages, illustrated; subject of the catalog, centrifugal pumps.

THE BALL ENGINE CO., Erie, Penn.; folder, 8½ x 11 in., six pages, illustrated; describes Type B Erie locomotive crane.

THE TABER PUMP CO., 297 Elm St., Buffalo, N. Y.; leaflet, 6 x 9 in., four pages, illustrated; describes Taber rotary type G pumps.

THE AUSTIN CO., Cleveland; booklet, 4 x 9 in., six pages; tells of Austin standard factory buildings, industrial plants and their equipment.

THE EDWARD F. TERRY MANUFACTURING CO., New York City; bulletin, 8½ x 11 in., illustrated; describes the "Contractor Locomotive Crane" as used under various conditions in construction work.

C. K. THOMAS AND CO., consulting export engineers, 10 Bridge St., New York City; booklet, 3½ x 5½ in., 10 pages, entitled "Service"; outlines the company's service to exporters, as consulting engineers.

THE INTERLOCKING CULVERT CO., Benham Bldg., Denver, Colo.; catalog, 9 x 11½ in., 22 pages, illustrated; describes various types and uses of "Wendelken" interlocking concrete culverts.

THE MARION STEAM SHOVEL CO., Marion, Ohio; booklet, 5½ x 8 in., 64 pages, illustrated; tells of various types and uses of Marion steam shovels, and includes information regarding the Marion factory and processes.

THE DAVIS-BOURNONVILLE CO., Jersey City, N. J.; pamphlet, 8½ x 11 in., six pages; describes the "Pyrograph," a machine designed for accurate cutting work in the boiler shop with the oxyacetylene torch.